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the Mecheleciv

VOL. 18 MARCH 1959 NO. 4

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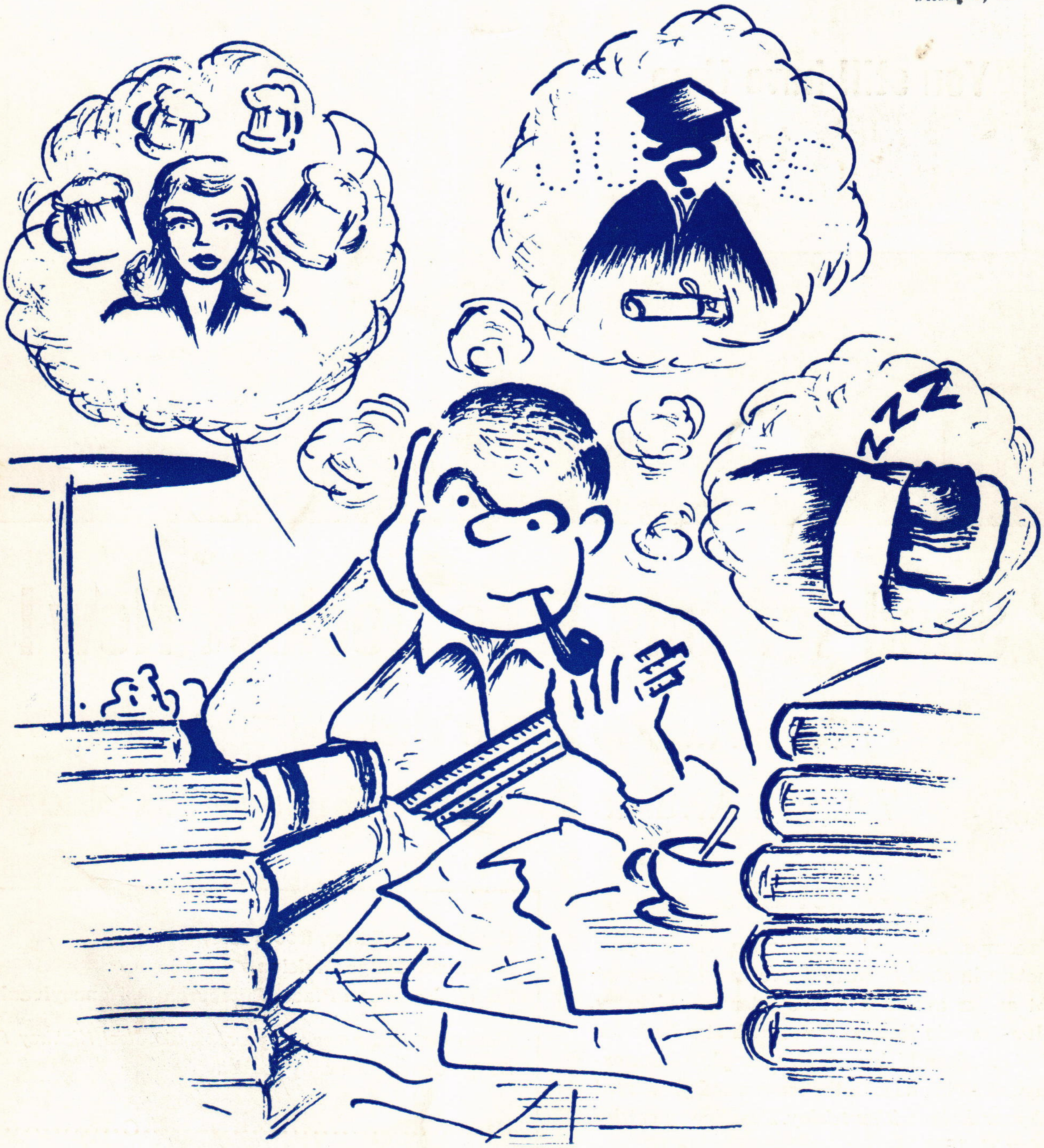

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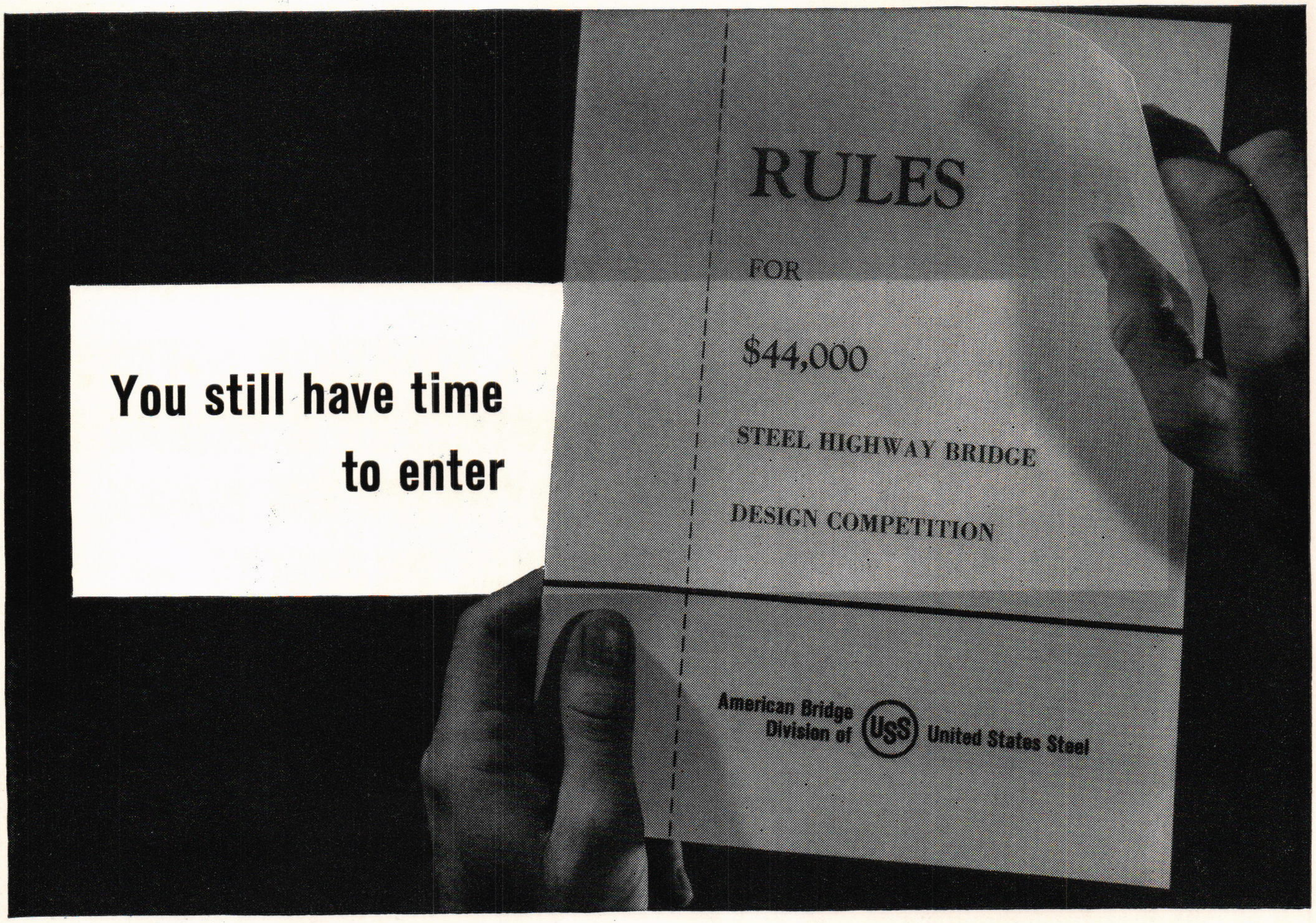

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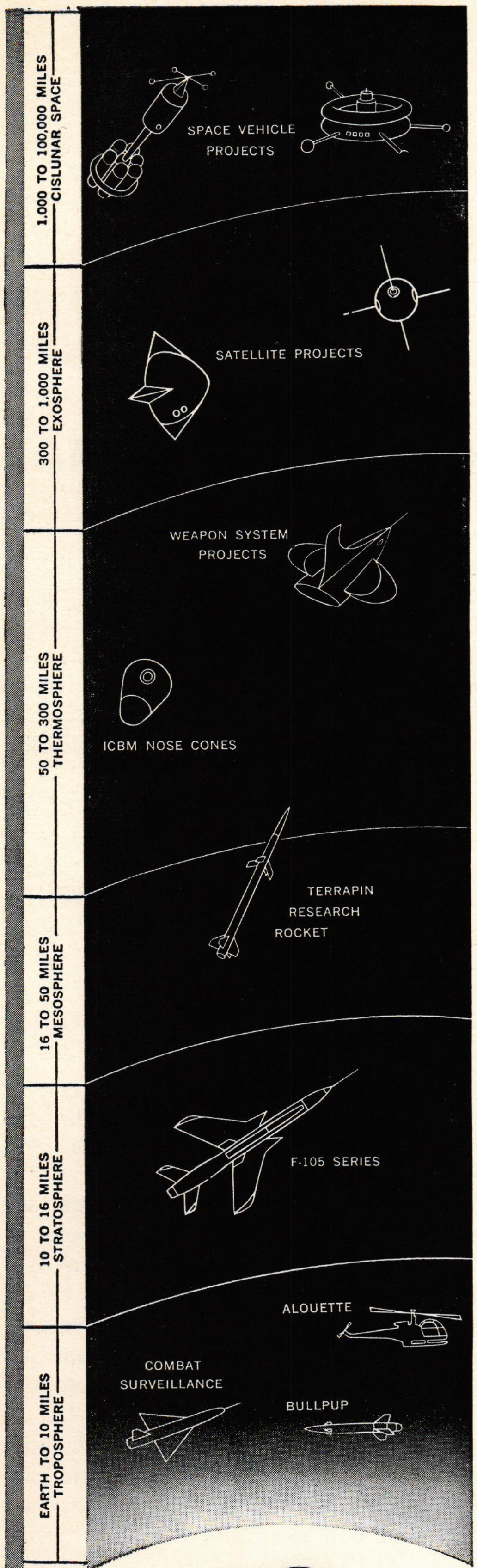

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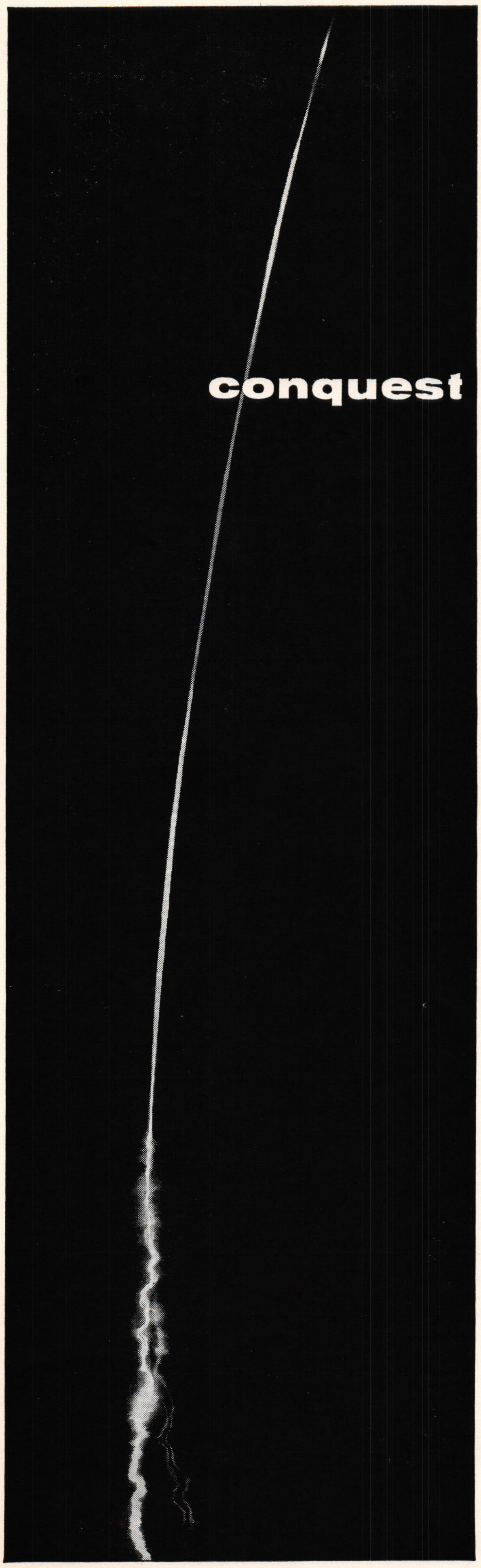

conquest of the thought barrier

Over the years, we have been hearing of many "barriers" in science . . . the sound barrier, the water barrier, the thermal barrier.

Of all the barriers, the hardest one to break through has always been the thought barrier. Every one of these "barriers" has been conquered by men to whom the word, impossible, means: "hasn't been done, *yet*."

The sound barrier is a shattered concept, as discredited as the phlogistic theory.

Don Campbell's *Bluebird* stopped all talk of the water barrier.

The heat of air friction against the metal "skin" of an airplane was supposed to create a heat barrier at Mach 3. Materials now in production can safely withstand the much higher temperatures involved in flight at Mach 5.

Today the thermal barrier is being called the "thermal thicket"—evidence in itself that no barrier exists.

An interesting point that all of these "barriers" have in common: each was conquered with the help of nickel-containing alloys.

This is not surprising when you stop to consider how many useful properties and combinations of properties are offered by the various nickel alloys:

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the Mechelecív

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In This Issue

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LETTERS TO THE EDITOR

Sir:

This is in reference to the article, "Baltimore and Ohio Transportation Museum," by John Prokop (*Mecheleciv,* Vol. 18, November, 1958, No. 2).

I wish to question the statements in this article concerning the failure of the "Stourbridge Lion", an early steam locomotive allegedly imported from England by the Baltimore and Ohio Railroad for use in the Company's testing of the new form of motive power . . .

During the course of research for my own term paper, "Legacy of a Man on An Iron Road", I ran across the name of the "Stourbridge Lion" many times. The highly documented nature of my research material assures me that the "Lion" was used not by the B&O, but by the Delaware and Hudson. All available facts fail to support Mr. Prokop's statement that the "Lion" failed to perform satisfactorily when tested. As a matter of fact, the locomotive was tested with a high degree of efficiency by the D&H at Honesdale, Pa., on July 24, 1829. The engine did not jump 300 or 400 foot radius curves. I doubt seriously whether the *B&O* directors ever felt disappointed by the performance of the "Lion". Indeed, the "Lion" later proved too heavy for the road as then constructed, it was dismantled and used as a stationary engine . . .

CHARLES R. GARTRELL

—Author Prokop was evidently in error. Since the "Lion" was owned by the Delaware & Hudson, I, too, doubt that the B&O directors were even concerned with the performance of the "Lion".

EDITOR

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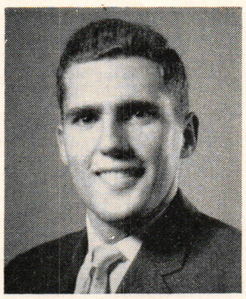
FROM THE EDITOR'S DESK . . .

with Woody Everett



Frank S. Endicott, director of Placement at the Northwestern University has recently released some interesting facts about employment in a series of his annual surveys. Briefly, the survey, which covers 205 companies throughout the U.S., indicates that there will be 13% more job offers to engineers, chemists, and physicists this year than last. The average monthly starting salaries look something like this: accountants—$422, sales—$419, general business—$413, engineers—$480. The monthly starting salary for engineers is slightly over the figure for last year: $475.

* * *

The Endicott survey also showed some interesting figures on the salaries of people who graduated between five and ten years ago: accountants—$783, sales—$866, general business—$788, engineering—$778. Engineers, with the highest starting salaries, don't keep pace with graduates in other fields as the years pass. This is a general indication that engineering graduates who want to stay at the top of the salary ladder must pass into management fairly rapidly.

* * *

A government study on technical jobs indicates that between 1958 and 1965 industry alone will need almost 10,000 more engineers per year than the colleges of the country will graduate. There seems to be no end to the critical need for engineers.

* * *

A survey conducted by Indiana Central College has turned up statistics that repels the justice-minded American. The survey indicates that 75% of all college seniors have cheated on exams at least once during their college careers. Even more alarming was the fact that 53% of the students questioned in the survey stated that they did not consider a scholastic cheater as being dishonest. When attitudes such as this exist among the elite collegians, how can anyone expect honesty in business, charity, and government?

* * *

The year 1958 saw another enrollment increase in the nation's universities and colleges. Over 3¼ million students enrolled in institutions of higher learning last fall—this is an increase of over 5% from the figures of Fall, 1957. There was also a conspicuous decline in the number of engineering students, though. Students enrolling in engineering declined over 10% from the figure of Fall, 1957. The government educational experts are moaning about this being a setback in a field vital to the security of the nation.

* * *

In an effort to make science, mathematics, and technical fields more glamorous to high school students, some schools are honoring students who get high grades in the stiffer courses. Along this line, the Carnegie Institute suggests that high schools compile a yearly "honors list" but recognize only the grades of the stiffer courses in an effort to encourage students to take the sciences. It seems that such things as honor lists are hollow glory when parents of the students brag about their football-playing sons and gloss over the brilliance of young scientists.

* * *

A good man to get acquainted with on the G.W. campus is Mr. Robert W. Reilly of the Student Placement Office. Mr. Reilly has recently taken the post as Placement Officer and is gaining the respect and admiration of the engineering students quite rapidly. It is refreshing to have a person that has new ideas and thoughts about this matter of recruiting. Members of all classes should become familiar with the Placement Office because its importance will be prominent during their last year at G.W.

THE EDITORS PAGE . . .

In the next three issues of *Mecheleciv* you will see some radical changes. No longer will the magazine follow a strict policy of printing only technical material; in fact, very few articles of highly technical nature will appear. You will notice particularly some of the new features of the magazine. These will include "Letters to the Editor", a column designed to give the readers an opportunity to express their views on subject matter in the magazine; "From the Editor's Desk", a page devoted to timely topics of interest to people in the engineering field; "Out of the Past", a column devoted to items of interest that appeared some time ago in the *Mecheleciv*; "Point of Order", a column of legal decisions of interest to the layman; "Historical Notes", a page of the exciting past of the U.S.A.; "The Editor's Page", which will be devoted to discussions of various matters by the Editor; and the "Thinker's Page", which will be devoted to topics that will provoke thought on subjects of humor, satire, and nature. Several of the old features of the magazine will be retained. These include "News in Industry", an up-to-date journal on latest developments in the field of industry; "The Alumni Review", which will feature the activities of engineering alumni; and the ever popular "Slipstick Slapstick", a conglomeration of current jokes and antedotes.

Heading up the list of articles for the last three issues of this school year will be a series of three articles on investments and investing by William H. Franklin, a pair of short stories by Robert Milton Moore, and several articles of pertinent interest to prospective engineers.

The staff of *Mecheleciv* hopes that you will enjoy these issues of the magazine and is always open to suggestions for improvement.

. . . EDITOR

MECHELECIV BANQUET SPEECH

By Assistant Professor Robert C. Willson

Department of Journalism

You good people can do more to help the School of Engineering than the Ford or Rockefeller Foundations. You can add thousands of dollars to your lifetime income and increase your own professional prestige if you'll stop trying to edit your magazine with your slide rules.

What I mean is that you can't continue to edit MECHELECIV by filling its pages with the same old tripe. You can't continue to be mechanical about publishing the same old stuff with a fresh cover. I'm not sure you can be civil about it either. You damned well better start to be electrical—I'm using the word to mean dynamic. Let me cook up a dream for you and explain what I mean.

The School of Engineering of The George Washington University could publish a magazine which would be read from coast to coast in industrial, governmental, and academic circles. It could be one of the best known publications in the general field of engineering. Think of it.

What would it mean—in terms of salary to new graduates, in terms of prestige of older alumni, in terms of salary and prestige to members of the faculty—if suddenly the GW School of Engineering began to be known as one of the very finest engineering schools in the country? (Don't think I'm knocking the School as it is today; I'm simply stating the fact that we don't enjoy that universal reputation today.)

I may be a little bit prejudiced by my field (journalism), but I don't think I'm overstating the case. I don't know whether or not there is a comparable journal in the field of engineering, but look at what the *Harvard Business Review* means to Harvard's business school. It is read by every academician in the field of business administration, it is subscribed to (and paid for) by some 9,000 libraries in this country and 2,000 libraries overseas; it also numbers among its subscribers most of the top-flight leaders in American business. And what is the result of all this grand readership? Just this: the Harvard School of Business is the best known school of business in the world. Its graduates are the highest paid of all graduates in the field, its older alumni make up a larger proportion of American businessmen in the over $100,000 a year bracket than the next five schools in the country, and its faculty is the highest paid in the country.

Stop your objection. I will not argue absolute cause and effect on this matter. But I'm sure none of you will argue that there is no relationship, or that the cause I see is really the effect.

Now I don't imagine that MECHELECIV can be transformed over night into an engineering equivalent of the HARVARD BUSINESS REVIEW. But I insist that it is possible to start with the bare bones of MECHELECIV and develop an engineering publication that will gather and maintain for itself, its editors, and its university an excellent reputation from coast to coast—and overseas, too.

But the task is not easy. It can't be done with a slide rule.

Let's look at the HARVARD BUSINESS REVIEW again. It's not a collection of jokes and cartoons; it contains no bald publicity; it does not confine itself to contributions from students, faculty, or even alumni.

It does discuss problems in its field; it does report the results of research in its field; and it does one thing that is even more important: it attempts to get out in front of its field and take a leadership position by bringing new problems to the attention of its readers and getting work started on solving those problems.

Can you approach this? If you don't think so, why not get together and write your jokes on the walls on the john and forget the whole damned business. I say you can do it. I say you can do it and make it pay you back a hundred times for the effort it will cost.

Yes; it will take an effort. It will take planning (I didn't say bull sessions). It will take determination (And I don't mean determination to fill up the pages). It will take a lot of time from a lot of people (it cannot be a part time job for one or two or even three or four men). It will take a lot of brains. (You can all sweat. The question is can you think.)

What are the problems engineers are facing today? What are the problems engineers are going to face tomorrow and the next day and ten years from now? Can you agree on the answers to these questions? If you can, begin your planning by attempting to get people working tomorrow morning on articles which will define and clarify those problems. Get some well-known men to work on solutions or suggested methods of arriving at solutions. Roll out the brains. You students and faculty members can become the thinking men's filters—that's the editorial job.

What makes you so sure that the president of General Motors wouldn't let you have the benefit of his thoughts on an important problem facing the entire world of engineering? What makes you think that the top army, navy, and air force engineers wouldn't be just as cooperative?

And isn't it possible that economists, geographers, people in the public health service, population experts, men in advertising, sociology, psychology, and experts from the Census Bureau have something of importance to say to engineers and potential engineers?

Think of all the people right here in this town who have something to say to you, to your alumni, and to engineers all over the world. To me, the possibilities are staggering. To you, the challenge is magnificent.

The rewards for success along these lines I think justify all the effort you must expend to achieve that success. Get with this dream. It can become a reality.

• • •

THE MECHANICS OF INVESTING

By William H. Franklin

The topic of investments may seem out of place in a magazine devoted primarily to engineers; but when you stop to consider that on an average you will only be an engineer some 40 hours a week and the remainder of that time a prudent provider for your family, what could be more important to you? Most engineers graduating from college today can expect to work between 20 and 40 years in return for a salary. Why not then let that salary, or part of it, work for you the same amount of time?

Contrary to what you may have thought in the past, investing is not strictly a rich man's game. If on the birth of one of your children, you began to invest $15 a month in a good mutual fund and reinvested your earnings as you received them, that fund would appreciate to a value somewhere around $13,000 by the time the child was ready to enter college, if the past decade can be any indication of the progress this country will continue to make. That is, with an investment of $4.00 a week or about 60¢ a day you could put that child through college twice! Now before you rush out with your 60¢ for today, let's talk about the mechanics of investing, provided you don't already know them.

The first and perhaps one of the more important considerations in investing is the selection of a good broker. Merrill Lynch, Pierce, Fenner and Smith is one of the oldest and most trusted names in the business. They were founded on the very principle of keeping the investor honestly informed. Offices are located in key cities all over the United States and Europe, and there are two offices in Washington. If you want to use another brokerage house, and there are hundreds of good ones, try to find out something about them first. If you can't, call the Better Business Bureau and ask if a complaint has ever been filed against them. Since most people don't like to advertise their being taken by a broker of questionable repute, this last suggestion will be no real indication of the integrity of a broker. It is always best to use one well recommended by friends.

No one, not even the most conscientious broker, will be as prudent with your money as you would be. For this reason, let us now consider the more technical aspects of investing.

Corporations raise money in two ways: selling ownership shares in the business in the form of common and preferred stock, or borrowing by issuing bonds. The name preferred stock is sometimes misleading, however, so let's qualify that security. When dividends are declared, those dividends due the preferred stock are paid first and if there are any dividends left, they are distributed among the common stock holders. Thus we see that preferred stock is preferred as to receiving dividend payments. Furthermore, should the business have to liquidate, the property of the corporation would be sold and used to satisfy the claims of the bondholders and other creditors; any remaining funds from the sale will be paid out to the preferred holders and then finally to the common holders. In this case, we see that preferred stock has prior claims over the common. These are the two main distinctions between common and preferred stock; further references in this article will be to common stock only, but can be considered, in general, to apply to both types.

In these times of "red ink" spending, the most serious parasite which feeds on our dollar is inflation. You may have heard, on occasion, someone say that bonds are no hedge against this menace. Let's see why. When you consider that you may buy for $25 a bond which matures in 10 years and pays 3% interest, you can see that you will earn about $8 at maturity. Add to this your principle, $25, and you will have $33 in your hand. Consider next, that after 10 years, $33 won't buy what it would have bought when you invested it; that is to say, $33 will not be worth at maturity what it was at the time you purchased the bond. This is the effect of inflation. On the other hand, if you had invested the $25 in common stock for the same period of time, as the dollar became more inflated, or the cost of living began to rise, all stock owners would sell their shares for more money as they would any other salable goods or commodity. They do this because it is costing them more to live, and stock prices, like all other items, would generally rise. If you were the owner of common stock during a period of increasing inflation, the dollarwise value of it would increase as the buying or selling price of the stock increased. But if you owned a bond during the same interval of time, you would be receiving fixed interest payments which were worth less and less as the dollar became more inflated. Simple—common stock "hedges" or counteracts the effect of inflation, but bonds can't.

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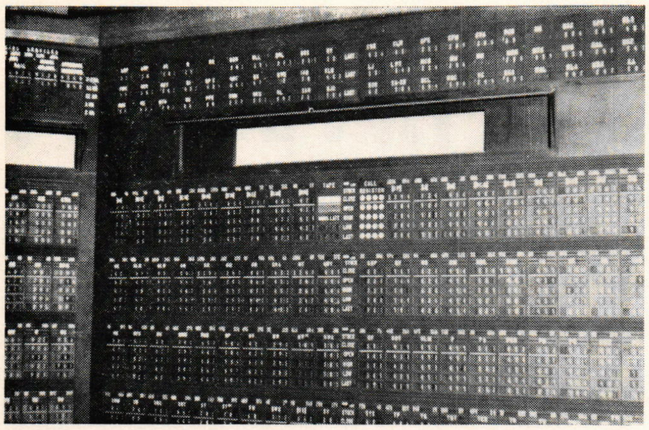

The total board at Merrill Lynch on which past transactions are recorded.

Suppose that you wish to buy a security. Where do you go to find a seller? In order to facilitate stock trading, these transactions are carried on mostly in market places called exchanges; the most famous one being the New York Stock Exchange. Your broker may be a representative of this and other exchanges and is equipped to handle all the technicalities of trading for you. Let us now trace what happens when you call your broker and ask him to buy for you 10 shares of Brown Paper Bag. The first thing he will do is quote you the last price he saw pass on the ticker-tape from the exchange the stock is traded on—say the New York Exchange. This ticker-tape is a direct connection to the Exchange floor and carries the current price at which stocks are selling. Suppose the last sale of Brown Paper Bag was made at $10\frac{3}{8}$ points. (A point is one dollar so $\frac{1}{8}$ point is 12.5¢). When this sale was made, it was recorded on the tape and will be the price quoted to you. If you think the price is too high, you may tell your broker to buy 10 shares for you at 10; on the other hand, if you want the stock fast because you expect it to go up, you may be willing to pay more; $10\frac{1}{2}$ a share for example. Let's say that the stock is thought to be over-priced at the moment so you tell your broker to buy 10 shares at 10. He will then pick up a telephone, which has a direct line to the floor of the Exchange, and tell his representative on the floor to place a buy order for 10 shares of Brown Paper Bag at 10. On the Exchange floor particular stocks are traded at particular counters, so this representative goes over to the counter which trades the stock requested and offers to buy 10 shares at the prices you ordered. If none is available at this price, he will not buy the stock for any more than you ordered, and unless you specified an expiration time for the order, it will stay on the floor until it can be met. If, however, you had told your broker to buy 10 shares and had not specified the price, the representative would buy regardless of how much the price had risen or fallen. At any rate, suppose a seller is found at $10 per share. The moment the sale has taken place, the price at which the stock was transacted will go on the ticker-tape, so that there only remains for the representative to inform your broker that the securities have been bought . . . the whole process takes about one minute. When securities are bought the way just described, the title to the stock is registered in the "house name", or name of the brokerage firm, until you pay for them. Most investors, however, will leave their securities registered in the house name even after they have paid for them, since selling is facilitated when the brokerage house "owns" the stock. Each month you will be sent a receipt which evidences stocks bought and sold for you during the preceding period.

Before we venture on, there is one added complication which should not confuse you if you understand what was just discussed: the man who receives the order from your broker does not actually go over to the counter where the stock is traded. There are only a few "sacred white cows" allowed on the floor of the Exchange so it is necessary to give the buy order to one of these people who will then run the errand for him. If you ever want to see something interesting when you are in New York, go to the Exchange and watch these transactions being carried on; it looks like an ant-hill. Something still more interesting is the American Exchange, where instead of utilizing slips of paper on which the buy order is written, sign language is used between the man who receives the call and the one down on the floor.

One last item . . . basically, there are three types of investors. The most popularly known is the speculator. He will buy a large quantity of stock, wait for it to appreciate a few eighths of a point, and then sell it. Sometimes he will make a fantastic profit, other times take a spectacular loss. For heaven's sake, don't speculate. With all his pyrotechnics, the speculator will not, in the long run, make a profit that will compare to a more conservative investor, unless he is unusually lucky. Sooner or later, his luck will run bad for a time and he could lose all his past profits. But alas! the glory of the speculator.

The other extreme is the ultra-conservative investor. His investments include nothing but "blue chip" preferred stocks, a few extra-safe common stocks, and quite a number of high grade bonds yielding 2 to 3% and maturing in 10 to 20 years. One rule to learn now is that the rate of return on an investment is proportional to the risk: the more risk you take, the more money you will make if the risk pays off. Neither extreme is desirable—too risky or too conservative.

Let's try in the middle. This third type of investor is sometimes known as a "growth investor". He is interested in the long term appreciation of securities and buys accordingly. He is prudent, but not a scaredy-cat; he will take risks, but won't speculate. Furthermore, he won't sell to capitalize a temporary gain nor cry over a minor loss. Should losses, however, constantly appear on one security, he will drop it and move on to another all the more wiser. With this realistic attitude, he is aware that possible gains and losses turn on his judgment, and in the long run will make these other two guys look like dirty spoons.

NEXT ISSUE: Mutual Funds and Dollar Cost Averaging: The Intelligent Investment?

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Some Idle Thoughts of an Idle Fellow

with Bob Moore

THE DARKEST NIGHT

By Bob Moore

God, it's dark. I've never seen it so dark; usually there's at least a glimmer of light somewhere to relieve the blackness. But then this isn't a usual night. No; no; this is a very unusual night, so it's only logical that it should be so dark. It seems like I've been walking for hours; I feel so tired, but then I've always enjoyed a good brisk walk in the evening, so I guess it's all right.

I wonder where Pete and Tom are; they were behind me just a moment ago. Oh well, I guess they sat down to rest; they'll catch up with me later, I'm sure of that. It's funny that I should be the only one still walking. I guess maybe those walks in the evening made me stronger than the rest. There were almost twenty of us when we started out, but the others dropped off one by one. Even Pete and Tom, my two best friends, and now I'm alone—the only one who's still going somewhere.

That's funny. I guess it's not really true; we're all going someplace, although I'm not sure just where. I never could satisfy myself on that. God, but it's dark up there. My sky, the heaven of my little universe, is pitch black; in fact, it's black as coal. Ah, but it's silly to torment myself. I may as well just forget about such things and enjoy my walk. It's nice to have someplace to go. As long as a man has an objective, a goal, he's alright because it gives him something to strive for, someplace to look forward to, something to take his mind off his troubles. Without a place to go, I would have gone mad. I couldn't sit and wait like the rest are doing; the waiting would be worse than what they are waiting for.

I've got to keep moving, keep walking—not think of what's behind me. I must think only about what's in front of me—about where I'm going. It's funny—everytime I think about going someplace, it brings me back to the same thought: We're all going someplace. Even though I'm the only one still moving, we'll probably all end up at the same place. At least that's what I think. I never could quite swallow that Heaven and Hell stuff; it's just too pat for me. Someone draws a line and says, "You step across that line and you'll suffer eternal damnation in Hell, but if you stay on this side, you'll go to a wonderful bright Heaven." Just too pat—too cleancut; life's not like that, and I don't think Death will be either.

But enough philosophizing. It's too late now for me to show the rest of the world the error of its ways. Yes; it's almost too late now for me to show anybody anything — because I'm almost there; I've almost reached my goal. A few more steps; only a few more steps!

This is it. I've made it. I'm the only one—the solitary leader. All my life I've been a follower. I've envied those who had the knack of leadership, the air of command. But tonight, when I realized what had happened, I promised myself that this time I would be the leader—not the follower—and I succeeded. I alone attained the goal which twenty men set out to reach. I've tasted the bittersweet fruit of success; I'm here.

But now I have no goal; now I can't control all those thoughts I've been crowding out of my mind; now I've nothing else to think of.

It's funny how it happened. We were all standing there—the whole night shift—waiting for the elevator to take us up when suddenly it happened. The whole mine shook; there was a tremendous cave-in in the mine shaft. Shaft #2 was completely closed off. We were all stunned for a moment, but then we all reacted to the coal miner's greatest enemy—gas. We all realized there was only one thing to do; one place to go. So we set out. But I was the only one who made it; I was the only one who made it to the end of Shaft #2—to the granite bedrock which had stopped the progress of the shaft.

Now I'm sitting and waiting — waiting for Death. My little journey has only postponed it a little longer. It will take the gas a little longer to seep down to this lower level, but it will reach here long before the rescue party. It's strangely fitting that I should die in a coal mine. I, who have spent more than thirty years of my life working in these same mines . . . I would liked to have seen Martha one more time . . . It's funny . . . it's strangely fitting; the end of Shaft #2—the end of my life . . . The truest dead-end that ever existed . . . I'm getting sleepy . . . so sleepy . . . God, it's dark!

The winking eyes so rich with light,
The breeze which stirs my soul's delight,

Eternity does seem so bright
When seen against this darkest night.

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EFFECTIVE COMMUNICATION: A MUST IN ENGINEERING

By Harold S. Horiuchi

> *"How much has happened in these 50 years—a period more remarkable than any, I venture to say, in the annals of mankind. I am not thinking of the rise and fall of empires, the change of dynasties, the establishment of governments. I am thinking of those revolutions of science which have had more effect than any political cause, which have changed the position and prospects of mankind more than all the conquests and all the codes and all the legislators that ever lived."*

These are words spoken by Benjamin Disraeli, noted British statesman, in 1873. These words are still applicable today, almost a century since Disraeli's time. The advancement of scientific and engineering technology during the first half of the 20th century has been even more phenomenal than that during the first half of the 19th century. We have witnessed, for example, an almost unbelievable change in the modes of transportation and communication. These advancements, for the most part, have been attributed to the scientists and their discoveries. But credit must also be given to the countless engineers who have taken the new discoveries and converted them into practical and useful products. Nevertheless, the credit today is being given the scientists collectively, including the engineers. In the eyes of the public, the scientist and the engineer are synonymous. In a semantic sense, there is a vast difference. It is not a new problem, but many of us in the engineering fields today feel that much of the publicity given the "scientist" should have been given the "engineer". In commenting on this feeling by some engineers, a representative of another profession stated in the December, 1958, *Product Engineering,* "The engineering profession won't succeed in the eyes of the public until it starts thinking of the customer instead of engineers". This statement should be given deep thought by all engineers.

In a nation deeply engrossed in democratic traditions, men have strong desires to participate in the determination of matters affecting them in community, church, civic, fraternal and other organizations. This is especially true among line supervisors and middle management officials in business and industry. I wonder if we can say the same for the majority of those in the engineering profession? Participation is possible only through a communication pattern which allows for effective expression.

As a student of engineering administration, I have become interested in the management aspects of engineering which involves not only technical management, but also organization, sales, personnel, and public relations management as well. Among the essential qualities the engineering manager must have in order to plan effectively and manage efficiently is the ability to communicate. He must be able to communicate with his subordinates, his colleagues, and his superiors, and he must be able to communicate with his customers—the public. This requirement applies not only to the engineering manager but to the entire engineering profession. It appears to me that perhaps this needed ability to communicate may be lacking among the engineers. Or is it possible that the engineers have the ability but also an aversion towards effective communications?

L. A. Allen, one authority in engineering administration, states that what is involved in communication is often misunderstood. It is often thought to be a matter of techniques—of knowing how to speak clearly, of putting up bulletin boards, and sending out announcements. This is only scratching the surface. Communication is the sum of all things one person does when he wants to create understanding in the mind of another. Allen defines communication as "a bridge of meaning". It involves systematic and continuing process of telling, listening and understanding. The significant fact is that wherever possible communication should be accomplished first-hand, not second-hand.

Most engineering tasks were not "projects" 50 years ago; they were just "jobs", and they were performed by men working alone or with just a few intimate associates. Communication was not a problem. Today work teams, in which several members of the same department are assigned a common problem, require teamwork in the accomplishment of a common objective. Task forces made up of members of various departments within the same company or agency, accomplish the same thing on a broader scale. Going one step further, in carrying out the vast defense projects of our country units of various companies are involved on a single objective. In each of these instances liaison through effective communication is necessary.

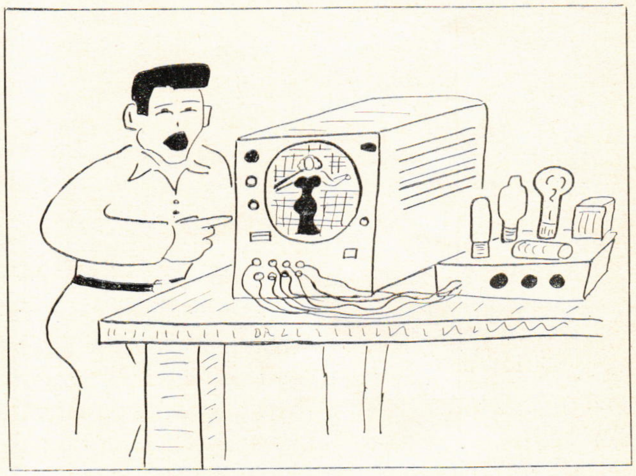
Dr. Eric A. Walker, President of Pennsylvania State University, speaking recently at the dedication of the Engineering Center and Research Park of National—U.S. Radiator Corporation has stressed the need for better communications by and among engineers. Dr. Walker, reminiscing of his boyhood days, spoke of a man in his home town who earned his living making small internal combustion engines. Although the internal combustion engine was invented in the 1860's, they were still rather crude devices. But the man was considered by many to be a scientist and engineer. Today he would probably be considered only a highly qualified mechanic. Dr. Walker recalls that with the help of just another man—an aged but competent machinist—this man ran the whole show, from designing and manufacturing (in lots of two and three) to testing and selling them. He made good engines, but he knew nothing about thermodynamics, elesticity or strength of materials. He probably didn't even really understand how his machines worked. But then this was typical of science in America at the turn of the century and even later, Dr. Walker continued. Science was used to explain how existing things worked, rather than to predict how non-existing things could—or should—be made.

The engineering profession has changed radically during the past 50 years. From the three basic fields of civil, mechanical and electrical engineering have branched numerous specializations, each of which can now be considered an engineering profession. Chemical engineering, automotive and aeronautical engineering, radio communications and electronics, nucleonics, industrial and quality control engineering, standards engineering, and the most recent, "reliability" and "environmental" engineering are but few of the specializations too numerous to mention. The typical engineering project today is complex and broad in scope and involves many specializations.

But as the engineering fields became more specialized, there has been a tendency for the engineer to contain himself more and more within a narrow sphere of interest, knowledge and contacts. This is the price we pay for specialization. This is all the more reason the engineer must grasp the techniques, problems and psychological factors in the field of communication in order to cope with problems which cut across his field of specialization.

Unlike the early engine builder who needed to communicate hardly at all, today the engineer must be able to communicate clearly, accurately and concisely at all levels and in all directions. Not only must he be able to communicate with his equal in other fields of engineering and science, but also with the "outer" world: that is, with management, with the "layman", and with members of non-technical professions.

Each of the engineering disciplines has its own language. With each new development or discovery, new words are added to the engineering languages. Thus communications across the engineering borders tend to become more and more difficult. The need to communicate in a common language, understandable by all concerned, has become imperative. The common language, in this country, is obviously the plain and simple English language. The English language, moreover, must be nontechnical to be understood by everyone, including the general public. Mathematics and formal "report" language may serve as media of communication from engineer to engineer, but communicating with the layman must be by skillful use of non-technical language.



Engineers communicate in a common language.

On the other hand, we should also note that our knowledge of semantics proves more and more that, at best, language is a limited vehicle for providing understanding among men when they have no basis in common goals or experience. Furthermore, for some people the matter of semantics is such that they tend to regard language as intended to conceal or obscure meaning.

The acid test of communication effectiveness is the amount and quality of understanding generated at the receiving end. An amusing episode can be reported here as an example of the engineer's apparent lack of effectiveness in generating understanding. In the effort to attract more students into the fields of science and engineering,

(Please turn to page 26)

HISTORICAL NOTES . . .

By Bill Franklin

100 YEARS AGO: AN INCIDENT AT CHARLES TOWN

"For the crimes of which you have been convicted, I sentence you, John Brown, to be hanged by the neck until dead on Friday, December 2, 1859. The hanging shall be public. I can see no reasonable doubt of your guilt. And may God have mercy on your soul."

The sentence read quietly by Judge Richard Parker rang out like thunder in the death-still Charles Town courtroom. Weeks before, Brown and his band of twenty-one men had shocked the Nation with a daring raid on the Harpers Ferry arsenal. His purpose: to free the slaves of the South and arm them against their masters. The result: twenty-one men dead, four of them citizens of the town, two of them Brown's own sons. The heroes of the event: one Colonel Robert E. Lee of the Union Army and his lieutenant, J. E. B. Stuart, a man with whom Lee was so unfamiliar that he misspelled his name in dispatches from the Ferry.

The press of the North howled and went over the injustice of it all. Threats to invade the South and rescue Brown and his men were widespread. Any stranger in Charles Town during the trial who couldn't account for his presence was immediately escorted to jail. Brown remained quiet; the country remained divided.

December 2 . . . Brown was dressed in a black frock and black pantaloons. He wore red carpet slippers and white socks. As he stepped out to board the wagon which was to carry him to the gibbet, the noose was already around his neck and the rope's length concealed in the bosom of his coat. There were four thousand soldiers in town, some of them lining the street to keep the crowds back. As the wagon rolled towards the field where the execution was to be held, Brown remarked, "I had no idea that Governor Wise considered my execution so important."

The wagon rolled to a stop. Brown jumped down and scrambled up the platform like he was going to a picnic. Cadets of the Virginia Military Institute stood rigidly at attention; at their head was a mathematics teacher named Thomas J. (later Stonewall) Jackson. His horse danced about despite attempts to hold her in line. On the platform, Brown waited patiently for his executioners to catch up with him. A cool breeze stirred a few leaves up at the foot of a beautiful white stallion and the horse moved around uneasily. His master, Captain Turner Ashby, would rival Stuart as a cavalryman in the then unthought-of Civil War. It looked like a dress parade.

After slipping a black mask over the Old Man's head, his elbows were tied securely behind him.

"Have you any last words?", his jailer, John Avis asked.

"No; just be quick."

As it was, however, he stood there another twelve agonizing minutes because a bungling officer had decided that a hollow square around the gallows would be a nice effect, but his boy soldiers couldn't follow the commands a farmer gives his plow-horse. Finally, all was ready and the signal was given to cut the line which held the trap-door closed. The rope suddenly snapped taunt; Brown kicked once and became limp, revolving slowly in a circle.

A young cadet named John Wilkes Booth in the ranks of the Richmond Grays became so sick that he nearly vomitted over the front of his pretty uniform. Idiotically, he asked the man standing beside him if he had a drink of whiskey.

Throwing her head from side to side, Jackson's horse pranced gingerly again as her master tugged at the reins.

It was a clear cool day.

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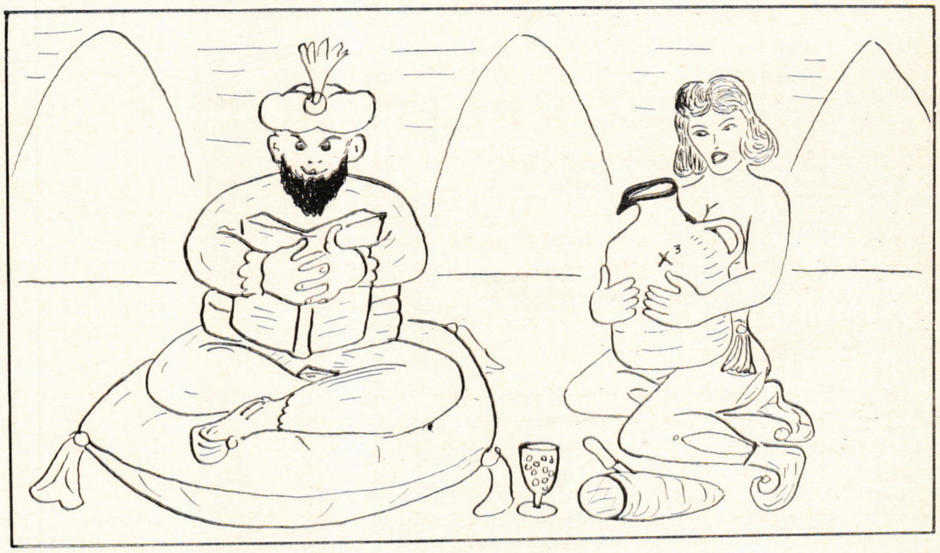
The Thinkers' Page



MARRY NOT AN ENGINEER

Verily I say unto you, marry not an engineer; for the engineer is a strange being possessed by many devices; yea, he speaketh in parables which he calleth formulae, and he wieldeth a big stick which he calleth a slide rule; and he hath but one Bible — a handbook.

He talketh away of stresses and strains and of no end of thermodynamics; he showeth always a serious aspect and seemeth not to know how to smile; and he picketh his seat on the car by the number of springs therein and not by the damsel thereon. Neither does he know a waterfall except for its power, nor the sunset except for its specific heat.

Always he carrieth books with him, and he entertaineth his maiden with steam tables. Verily, though the damsel expecteth chocolates, when he calleth, he opens the package to reveal samples of a new alloy.

Yea, he holdeth a damsel's hand, but only to measure the friction, and he kisseth only to test viscosity. For in his eye shineth a faraway look which is neither love nor longing, but a vain attempt to remember an equation.

Even as a little boy, he pulleth a girl's hair, but to test its elasticity, and as a man he discovereth different devices, for he would hold a maiden to his bosom only to count the palpitations of her heart, and to reckon the strength of her materials.

Alas! his marriage is a simultaneous equation, involving two unknowns and yielding a periodic function.

. . . ANON.

VACCUM INSERTION OF HEATERS

By Ray Howland

One of the problems in the manufacture of electronic component parts is the insertion of coil-type heaters in the cathodes of electron tubes. This problem has grown more acute as the size of the tubes first went to miniature and then to subminiature. Since a minute crack in the insulation of the fragile, coiled heater is considered enough of a threat of failure to warrant rejection, this problem assumes momentous proportions when it is realized that some 25% of the heaters made have to be scrapped.

Recently, however, a significant improvement was made by using air to move the heater into the cathode instead of manual motion.

The coil-type heater is made by coating a coil of very small (approximately 0.0009-inch diameter) tungsten wire with a ceramic coating. This coating must provide electrical insulation between the heater and cathode and between the turns of the coil. In the coil-type heater, there are usually more than 700 turns per inch. The coating must also provide most of the mechanical support of the coil.

So critical was the insertion of heater coils that the operation was on the borderline of human capability. With the operator holding the assembly in one hand while inserting the heater with the other, it is always very difficult to maintain a steady movement during insertion with no lateral bending forces. Considering the heater's extremely fragile construction either of these is likely to cause cracking. The difficulty of manual heater insertion was made evident by the long training time required before an operator became proficient. Also, the observed relation between emotional upsets of experienced operators and marked increase in defect levels was taken as additional tangible evidence of the extremely delicate nature of this operation.

One might conclude that the heater should be made less fragile but the heater's fragility results from its function—the supply of the heat which maintains the cathode and its active coating at a temperature (about 1100 degrees centrigrade) required for optimum electron emission. The minute dimensions of the tungsten wire coil, which account for the fragility of the heater assembly, are established on the basis of three factors—the amount of heat required (translated into terms of electrical power), the desired operating voltage of the heater, and the operating temperature of the heater. Miniature tube cathodes commonly require about one watt of heater power. For optimum conditions of heat transfer and heater life, heater temperatures are held about 1100 degrees centrigrade.

The original miniature tubes were designed for a heater voltage of 6.3 volts. The heaters were made of 0.00123-inch diameter tungsten wire of about 3 to 4 inches long. By folding insulated wire into 5 to 7 folds, this length was made to cover the entire length of the cathode (½ inch) to achieve fairly even temperature distribution over the cathode coating, thus avoiding the difficult coil-type construction.

It was recognized that in some systems many of these tubes would be used. Where a supply of 6.3 volts is not readily available, it was desirable to convert the tube designs to provide heaters capable of operating on 20 volts. The physical change to the heater was in the direction of smaller diameter wire and greater length. The twenty-volt heater for a 407A tube is made of 0.00094-inch diameter wire 16 inches long.

If made by the folded design the 20-volt heater would require about 32 folds, more than could fit in a cathode. The coiled design accommodates the length in a reasonable size. The ceramic coating is used to provide insulation and support for the coil. Its fragility results from the changes in operating voltages of the tube.

When the problem arose in making the 20-volt heater, much effort was expended in improving the condition of the heater supplied the operators. The coil-type heater with its ceramic coating is shaped like a V. In the insertion process, the angle between the two sections of the heater is important. If the angle is too small, the heater will fall through the cathode; if the angle is too large, the heater will be cracked when it is inserted. The ideal angle size was determined, but the heater insertion was still a troublesome operation.

The final solution to the problem was based on the use of a vacuum induced air stream to move the heater into the cathode. The assembly is placed in a jig which is connected to a vacuum pump. When the openings in the jig are obstructed by the assembly, a partial vacuum is induced which is sufficient to hold the assembly in place, and a substantial flow of air is directed through the cathode.

The final position of the heater within the cathode is determined by an adjustable cushioned stop. The rate of air flow can be controlled by means of a needle valve on the pump so that it is just sufficient to move the heater through the cathode at a speed to low to cause damage when the heater hits the stop.

The use of the new method has eliminated scrapping of so many heaters that it has given significant labor savings; the time of the operation has been reduced; and the microscopic inspection of the assembly after heater insertion has been eliminated.

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AUTOMATIC TEMPERATURE CONTROL:

A CHALLENGING FIELD

By Jack O'Neale

*Jack O'Neale was born September 16, 1935, here in Washington. After finishing Gonzaga High School, he attended Notre Dame for some three semesters. Here at G.W. Jack is Vice President of the Engineers' Council, Regent of Theta Tau, Office Manager of **Mecheleciv**, and a member of ASME. Jack is presently employed at Johnson Service Co. as a Technician and will receive his BME this June. At the present time, his future includes work toward a Masters Degree.*

During the last sixty years, great changes have been made in types of architecture prevalent throughout the world. In the United States the major changes have occurred in the urban localities. The trend in the heavily populated areas has been to apartment buildings and large office buildings in preference to the individual residences and one-company offices of past years.

One of the major problems encountered in this trend has been the comfort of the people who occupy these buildings. These problems were, in part, overcome by the development of newer and better heating systems and the introduction of air conditioning on a large scale. At the same time, the problems involved in controlling these new systems increased. These innovations in the field of architecture and the heating industry brought about the advancement of the automatic temperature control industry.

As more and more people were brought together in one building, the problems involved in maintaining their comfort increased rapidly. In the early days of the industry, it was considered excellent if temperatures could be controlled within $\pm 5°$ of the desired temperatures. Now it is necessary in many instances to maintain temperatures within $\pm 0.5°$ and humidities within 2%. These limits must be maintained through the use of radiant heating and cooling panels, unit ventilators, single and multiple temperature air distribution systems, high pressure-high velocity air systems, individual room units, or some combination of these systems. These systems may utilize hot water, steam, gas, high temperature-high pressure water or combinations of these for heating and chilled water for cooling.

The increased demands on the limits of control coupled with the development of these new types of heating and cooling systems have made the temperature control industry one of the most challenging businesses in the construction field.

In this field there are many factors affecting the comfort of persons occupying a building which must be taken into consideration. Among the most important factors are the outside temperature, the heat transfer from the building, the radiant heating of the sun, and the variation of heat load in the building. The first factor is readily overcome by incorporating in the design a control system which compensates for the effects of changes of outside temperature. The effects of heat transfer cause little trouble if the system is properly sized and the components properly located. The radiant heating effect of the sun is not so readily overcome. This effect is mainly dependent on the total window area in the building and it varies with the exposure. In order to compensate for this, the intensity of the sunlight and the outside temperature must be measured and the inside temperature set accordingly. The variation of the heat load in the building causes many problems, especially in installations such as auditoriums or theaters. In these cases, the method used to control the temperature is similar to that used to compensate for the effects of outside temperature; the supply temperature is decreased in direct proportion to the increase in temperature in the area. The main problem lies in the fact that the changes in temperature in these places take place rapidly since most of the people enter and leave at the same time. The solution of this time problem is a function of the individual installation and there is no set method of overcoming it.

(Please turn to page 20)

NEWS IN INDUSTRY

"RED HOT" MOTOR: An electric motor which operates continuously over extended periods of time while completely immersed at temperatures of nearly 1000 degrees Fahrenheit has been developed by scientists of the Westinghouse Electric Corporation. The motor is believed to be the first to have operated in the thousand-degree range for any appreciable length of time without some form of artificial cooling. It has run for more than 100 hours while sealed inside an oven at 950 degrees Fahrenheit. The motor was designed to test, in as severe a practical application as possible, the performance of a new system of electrical insulation for motors, transformers, relays and other electrical equipment required to operate at very high temperatures, such as those encountered in the supersonic flight of jet planes, missiles, rockets and other high-speed aircraft.

ATOMIC POWER: Twenty-four-hours-a-day preparations for placing into operation the world's first full-scale atomic-electric generating station devoted exclusively to civilian needs have been climaxed now that the plant at Shippingport, Pa., is producing electric power for use in Greater Pittsburgh homes and industry. Before this historic feat could be accomplished, detailed testing of every phase of the pioneering plant was conducted by engineers and scientists of Westinghouse Electric Corporation, Duquensne Light Company and the U. S. Atomic Energy Commission. At full power the reactor plant can produce a minimum of 60,000 kilowatts of electricity.

SONAR NOISE: Scientists have had the first detailed look at the billions of "somethings" in the sea which are believed to cause most of the noise that jams sonar systems—the underwater "eyes" of the Navy. The look was obtained aboard a Navy submarine in the Gulf Stream off the coast of Florida. Using short bursts of ultra-high-frequency sound waves, Westinghouse scientists probed the sea to pinpoint individual underwater "scatterers" of sonar signals. If present theories are correct, these scatterers are most likely some form of marine life, but their exact nature is a mystery. At a depth of 380 feet the scientists found an average of one marine animal in every two cubic yards of Gulf Stream water. Nearer the surface, the scatterers were up to 25 times more numerous, but also up to eight times smaller in size as measured by their ability to reflect, much like droplets of fog disperse and reflect the beam from an automobile headlight. They produce a confusing jumble of unresolved echoes, or noise, that limits the range of sonar signals and interferes with their clear reception.

UNION DOME: The world's largest circular building, Union Tank Car Company's Union Dome nearing completion at Baton Rouge, La., will be one of the most strikingly colorful buildings in the country. The exterior surface of the huge dome will be painted bright yellow and will appear to have a bluish haze because of the royal blue paint on its external supporting members. The total exterior panel surface area to be painted is 154,900 square feet. The dome is 384 feet in diameter and approximately 10 stories high (120 feet). It consists of 321 hexagonal steel panels welded together and strengthened by external supporting tension and compression members. The dome has no internal supports whatsoever, thus permitting complete flexibility in interior layout and in movement of men, equipment, and materials. The Union Dome is the first major industrial use of a geodesic dome and will serve as a regional tank car repair and maintenance plant for Union Tank. The dome is expected to be in full operation by the middle of October, 1959.

"TROJAN HORSE": A unique device that permits engineers to test materials by subjecting them to the explosive force of an atomic bomb, but without the use of any radioactive materials, has been developed by Boynton Associates of La-Canda, California. The unit consists of a 20-ton steel pressure vessel, roughly cylindrical in shape, mounted on top of a 75-ton heavily reinforced concrete pier. Engineers place the item to be

tested, such as a beam, inside the steel shell. A firing tube, also contained in the shell is loaded with enough primacord explosive to produce the desired blast. The test device is officially known as an Atomic Blast Simulator, but because of difficulties encountered in building it, workmen dubbed it the "Trojan Horse".

RADIATION-MEASURING SKIN: An artificial human skin may pave the way to protection of high-flying pilots. Scientists have described a device which is expected to measure effects of radiation such as a pilot may face from direct sunlight high above the earth. This would provide information to enable designers to produce proper clothing and atmosphere for those exposed to this type of heat, said the scientists. The device consists of a material simulating human skin laid over a metal cylinder. Temperature is controlled both above and below the "skin" surface and instruments measure the temperature through it. Results are computed from a special formula.

COOL FINISH: A new finish called "Fro-Zon" is now being applied to stainless steel, giving the shiny metal a frosty appearance. Developed by Stamping Service, Inc. of Detroit, Mich., the new finish is being used on automobile trim sections of stainless steel. The finish is made possible by a type of "semi-blasting" technique which gives the medal a frosted look by forming tiny mounds on the surface of the metal. This process, which is put on very lightly and does not penetrate the surface of the metal, diffuses light rays and gives the frosted appearance. All kinds of patterns, lettering, bossed, deposed, flat or contoured surface, can be handled by the new process. At the present time the company has done work only in the automotive industry, but expects to take this process to other fields shortly. The developers are aiming at the home appliance, architectural, furniture, toy, and related fields. Cooking utensil manufacturers are expected to be interested in the new finish, too.

INDUSTRY STATISTICS: The National Science Foundation has just released a preliminary report on results of an industry-wide technical manpower and Research and Development survey. Highlights: In January 1957, 528,000 engineers, 152,000 scientists, and 58,000 administrators of scientific and engineering activities were employed in industry. Close to one-third of the engineers and scientists were engaged in R&D activities. Industries employing the largest number of engineers: Electrical Equipment Mfg. (75,200), Aircraft (66,000), Machinery Mfg. (62,500), Non-Mfg. Industry (122,000). From 1954 to 1957 industrial employment of engineers and scientists increased by 30%. The increase of 100,000 engineers is greater than the number that received BS degrees during the same 1954-57 period.

COOLING COMPUTER: How large an air conditioning unit is required by a seven-room ranch house, facing northwest, and shaded by a grove of oak trees? An electronic computer developed by engineers of the Westinghouse Electric Corp. will analyze the facts about this dwelling and in 24 seconds come up with the answers to its cooling needs. The computer presents a new approach to an old industry problem—that of determining and properly specifying how much air conditioning capacity is required in a particular house at a particular location. In ordinary commercial practice, determining and specifying the proper cooling needs by the installer leaves much to be desired. When a unit is undersized, insufficient cooling and poor temperature control may result. When oversized, the initial cost is excessive, penalizing the customer. In addition, the unit may run too infrequently to provide proper humidity control. The computer is likely to find application in major housing projects where many homes are basically similar in construction, but varied in design, size and juxtaposition—factors which influence the size of the air conditioning unit which should be selected for each home. The computer, known as Warac to signify Westinghouse Analog Recording Air Conditioning Computer, is designed to consider systematically over 50 factors which influence the indoor temperature of a house.

MOLTEN BRICK: Graphic proof of the intense heat produced by the arc image furnace is a close-up (see photo this page) of the melting of a piece of high-temperature fire brick. Seconds after being exposed to the high energy beam of the arc image furnace, the brick begins to melt and the molten material literally flows from the crater. Only materials that are capable of absorbing the radiant energy of the beam can be heated —a shiny object would remain relatively cool, while a black body would become extremely hot.

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OUR ENGINEERING RESPONSIBILITIES

John M. Burnham

All of us have ideas relating to engineering design, which have been strongly influenced by our background of related experience.

Some of us have had a variety of practical experience which can be related to our chosen field of engineering; some are familiar with machine shops and shop procedures, with the vagaries of practical electrical trouble shooting, with the difficulties relating to corrosion control. Some of us have had design responsibilities, or have dealt with administration and human engineering. There are others whose contact with engineering has been primarily academic.

With many schools requiring or considering five-year undergraduate engineering curricula, we can recognize the limitations set upon our faculty in determining what courses may best prepare us for the engineering profession. Schools all across the country have been cutting out the courses which aim at giving the engineering student a feel for the mechanics of a practical problem in favor of developing an analytical approach to all engineering problems based upon as broad and thorough a theoretical foundation in all related phases of engineering as the hours allotted to technical studies will permit. The academic staff believes—and rightly so—that the mechanics of the profession one chooses will be mastered as the need arises, and that the scientific fundamentals upon which the mechanics are based are the essential preliminary, which can be gained most efficiently in the atmosphere of an educational institution.

This does raise the problem, however, of practicality in engineering. As we gain experience in engineering, we will need to learn the things to look for: the approaches that our supervisors have discovered to be the best. The pitfalls that trap the unwary will trap us too, but we will learn our way around them as time goes on.

My experience has been related to the sea. Even in the relatively brief span of years since World War II, many of the time-honored skills which marked the "Old Salt" have died with him. Ships have changed, and so have the men who sail them.

The days of the thoroughly practical indoctrination of the young cabin boy into the way of the sea; of the continued training, hard and rigid, until he in his turn joined the ranks of the real seafaring men—these days are, for the most part, gone. For every able-bodied seaman who has been able to pass on his skills, diligently and patiently, there have been many more who could not do so. With the press of day-to-day work and an increasing cost-consciousness in management, we now have a large group of seamen whose experience lacks depth, and whose capabilities therefore are limited.

What about us, in the here-and-now? We are the oncoming engineering profession. Our graduating classes augment the staff of design offices and industrial firms across the nation. Look at the advertising offered by the various firms who would encourage us to seek employment with them. These advertisements portray their company as having an ideal environment for creative engineering; we will be assuming supervisory design responsibilities shortly after the training courses sponsored by the company are completed.

The engineering shortage thus has demanded that we show our mettle shortly after we start to work. And with high productivity being extremely important, supervisors will not have the time to pass on all of the knowledge which we might desire to help us assume our responsibilities. We will be expected to dig for ourselves, just as the young ordinary seamen do today.

Here is where we should stop this analogy. We are much better prepared to become engineers than the apprentices are to assume their seafaring duties. But at the same time, the practical approach to our design objectives should be considered. The final design of an engineering office must represent a functional product. No matter how much "research" is done, its ultimate end is to devise some practical, workable thing; some improvement, great or small, which will displace its forerunners; some new idea which has been developed to take its place among today's useful products.

An adequately engineered product should represent a near optimum for its function. It should cost as little as possible to produce. It should be easier to manufacture than comparable rival lines, and offer a bonus to its user in terms of built-in dependability, simple maintenance, and easy periodic overhaul. It may be required to fit into cramped quarters, deliver more power per pound, or be capable of modification to suit other service conditions. It should be made up of as many standard components as possible, commercially available and properly chosen for their duties. It should have the absolute minimum number of moving parts; all must be protected from each other and outside influence and must not do the user harm. It should meet the regulations governing all of its possible fields of utilization.

I once overheard a story related to an architect recently graduated from a fine engineering school. He joined a firm of professional architects in a large Eastern city, at an adequate salary. He left after a few months, however, because, as he put it: "Did I go to school just to learn to design outhouses?"

No doubt that each of us in the near future will be doing some "outhouse designing" of our own. In what other way can we hope to gain the experience which will let us start to design whole units?

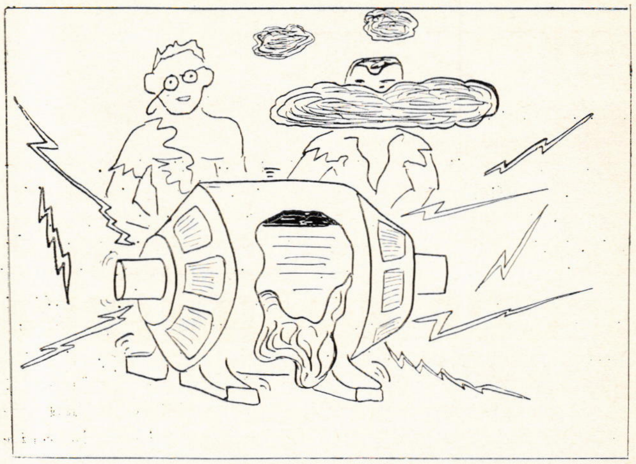
I believe that we have, in engineering, a responsibility to our selves: that first and foremost we must do the very best job of which we are capable for each task assigned. Perhaps the best approach is to be humble in our ignorance, rather than proud in our potential.

If we are to create a better design, then we have to consider, for each component, the very real criteria of practicality and functional efficiency. We must count the cost: to design a beautiful unit which is much more expensive than its competitors is to put your company out of business. Industrial and Production Engineering begin in the design office. For our particular segment of the design we must consider, essentially; simplicity and economy; with sub-groupings of:

Safety,
Governing Regulations,
Over-design versus Malfunction
Construction Tolerances
Materials,
Methods of Manufacture,
Standards and Standard Sub-units,
Testing,
Maintenance,
Accessibility—all within the economic restraints by which we may be limited.

We must be safety conscious in the extreme; any moving part is a potential hazard—can it be eliminated? If it must exist, how may it best be placed to minimize hazard? It must be guarded and shielded. Safe electrical and electronic circuitry are the subjects of many newspaper and periodical articles.

What goes into a "better mousetrap"? Basically, it can only be better as a result of attention to detail. It should be maintenance-free, if



A supervisor must know his job.

possible, but the maintenance techniques must be simple and easy to perform. What do engineers care about maintenance? This depends upon the restraints of the market and what other companies do. Try to take the cover plates off your sparkplugs if you have a V-8 engine and a hood full of power accessories. Ready accessibility is a "must" too often neglected.

How about service life? Somebody has to decide on how much of what material it takes to make the product "go the course". Materials engineering is a field all to itself, yet we often must do our own.

We all can think of examples of poorly designed items. Can we see, as well, those representing excellent attention to detail?

What about the question raised by the foregoing? Who is the man who takes the preliminary design and fits it into the capabilities of the shop, the economics of the competitive world, the tolerances of necessity, the materials of today, the working man's maintenance ideas? Who does this mass of detailed work?

I feel that we have a definite responsibility to our company and to ourselves to be prepared to do well the common sort of day in-day out engineering; the cut-and-try processes of fitting together the components of a unit in the best possible way.

It isn't fair to assume supervisory responsibility for a phase of a project unless you know all about it. I don't mean the details of a design program that hasn't yet left somebody's mind or some customer's specification sheet. I mean, rather, that you must have a grasp of all the foundations, all the cornerstones of practical engineering, which can only come through experience acquired in the accomplishment of these seemingly trivial and unimportant details; that you have the technical as well as the administrative ability.

It is my feeling that we must make ourselves look past the drawing board, and into the environment where the item on the board will be used. It is essential, where we cannot see the whole picture, that we ask questions to fill in our knowledge. This approach to engineering is the path that we must follow, as the only means to developing our engineering potential into design capability.

• • •

POINT OF ORDER

with Bill Franklin

At some time or the other, we must all check or bail some piece of property for convenience. It may be a hat or coat at a restaurant, a car in a parking lot, or a trunk at the train station. In receipt of this property, a small check stub is usually given to evidence ownership later when the hat, car, or trunk is reclaimed. Should the bailee, the person who keeps the property, be relieved from liability in case of loss or theft even when a clause on the stub given to the bailor, or owner, states that he is? Consider the following case.

This suit concerns action on a contract, begun by a writ dated 1949, in which the plaintiff, whom I shall call Smith, sues for the loss of his trunk and its contents. The defendant, whom I shall call Speedy Delivery Service, is an intrastate carrier; that is, delivers goods only in the state.

There is evidence that Smith arrived at South Station in Boston with his trunk and walked into the establishment of the defendant with it. After checking the item, Smith received a pasteboard card about two inches square which had the number 549-G on one side and on the other the following: ". . . this establishment is not responsible for property lost whose value is greater than $100, unless at the time of bailment, a declaration of higher value is made by the owner". Smith took the card without looking at it and put it in his pocket. Subsequently, the trunk failed to be delivered at the plaintiff's home and the Speedy Delivery Service admitted that it had been lost.

Mr. Smith sued the Speedy Service on the claim that the trunk and contents were worth far more than $100. The defendant, however, claimed liability only up to $100, since the plaintiff had not made any declaration of higher value at the time the baggage was checked. To this Smith countered that he had not even read the card and was not aware of the terms of a contract that appeared on it. The case was then submitted to the jury and above the objection of the plaintiff, the judge instructed them that ". . . acceptance of what purports to be on its face a contract in return for property bailed, binds the bailor, regardless of whether or not he is aware of the terms of the contract." Still, the jury awarded the defendant $1700 to which Speedy Delivery Service appealed.

What would be your decision if you were the jury in the appeal case?

* * *

The judgment stood. Smith's lawyer agreed that the instructions to the jury in the first trial were correct. When a ticket, however, is given mainly for *identification* purposes, as is the case here, terms written on the ticket can not bind the bailor *unless* his attention is called to them at the time the property is bailed.

Remember that the next time you check your car in a parking lot.

(Based on a 1953 decision)

AUTOMATIC TEMPERATURE CONTROL

(Continued from page 15)

After accounting for these factors, the actual design of the complete control system can be completed. The entire system must be designed for a maximum of comfort with a minimum of operational and maintenance costs. This involves selecting the proper equipment for the installation along with the proper type of controls. The controls may be electric, electronic, pneumatic or a combination of these. The most widely used systems are electric or electric-pneumatic. Both of these systems have their advantages. In many instances where the initial cost is the deciding factor, electric installations are preferred, but when operational and maintenance costs are considered, the electric-pneumatic system is usually chosen. There are many reasons for this, the main one being that pneumatic systems are less complex and have fewer components per instrument. Also to be considered is the fact that each electric control instrument consumes power while the only power consuming device in the pneumatic system is the air compressor. This means that the operational costs in an electric system are usually about 15 times greater than in an equivalent pneumatic system.

The actual selection of equipment depends on the particular installation. Some control systems are completely self-sufficient and index themselves from heating to cooling or from day to night operation. Other systems require the manual operation of one or more switches to perform this operation. Some systems require only heating cycles; others, heating and cooling. Some systems, i.e. those used in warehouses, do not demand high limits of control, but others, i.e. those used in hospitals and electronic equipment installations, demand extremely accurate control. Many other factors too numerous to mention must also be considered before a system can be completely designed.

After the design comes the actual estimating and bidding of the project. If a contract is obtained, the next step is the actual installation and setting up of the control sysem. This is a complete cycle of operation in the temperature control field.

The engineer who works in this field is not tied down to one type of work, but must be a "jack of all trades". Primarily he is an estimator and salesman, but he must also be a designer, consultant, economist and construction superintendent. He is responsible not only for obtaining contracts, but also called upon to design control systems, write specifications, oversee the installation of these systems and resolve any and all problems that may arise. This is truly the field for those persons who enjoy varying and challenging work.

• • •

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Alumni Review

Bernard Bernstein, (B.S. '42, BME '47, MS '54 Md) is now living in Plainfield, New Jersey at 522 Pemberton Avenue. He is the General Manager of the Ordnance Systems Division of Gulton Industries, Metuchen, New Jersey. This division is engaged in fuzing systems for missiles, sonar systems and AEC projects. An ex-professor at GW, Bernie would like to hear from his former students and classmates.

M. Michael Brady, a former Mecheleciv Editor, received a Fulbright Grant to study for one year in Norway which began on June 28, 1958. After traveling a bit between the Summer and Fall sessions, he returned to the University of Norway where he works with the Norwegian Defense Establishment. He can be contacted at

Forsvarets Forskningsinstitutt
Avdeling For Radar
Bergen, Norway.

Best use Air Mail, otherwise it will take the letter about two months to reach him.

Harry M. Brandler, (BEE '55), is now a consulting field engineer with Standard Electric Time Company. Although his work requires him to travel all over the US, he enjoys it very much. Furthermore, Harry is the proud father of a baby boy, David Joseph.

David C. Colony, 2952 Kendale Drive, Toledo 6, Ohio, suggests that we include a Letters to the Editor section in the Mecheleciv, along with some editorial comments on the professional status of the engineer. Letters to the Editor can be found in this issue, Dave.

OUT OF THE PAST

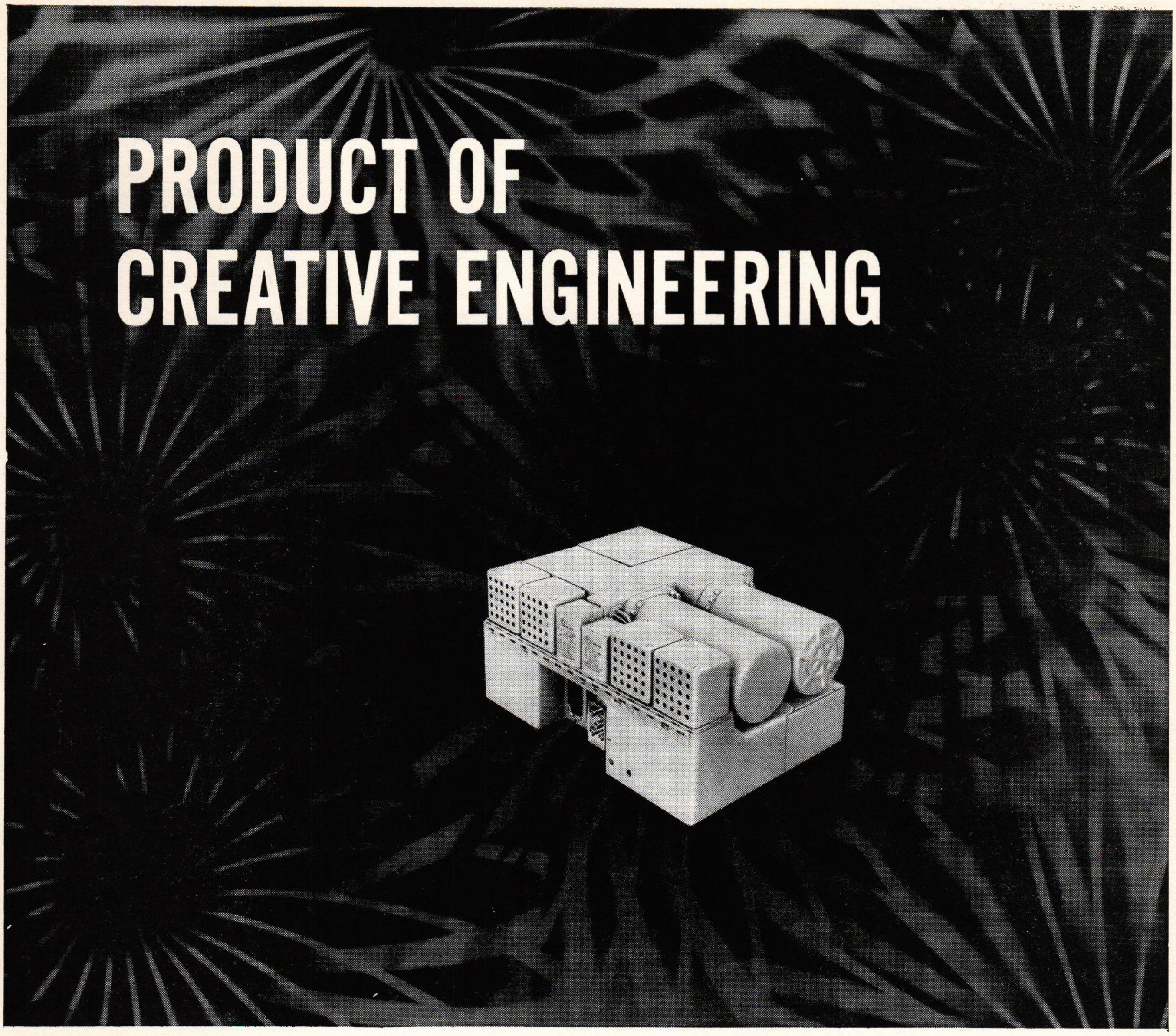
April, 1956: "Professor Norman B. Ames, executive head of the electrical engineering department, has been awarded a Fulbright lectureship in electrical engineering at the University of Ceylon . . . Professor Ames has been on the faculty of the School of Engineering for thirty-five years. He served his country in two world wars and now holds a reserve commission as Colonel in the Air Force."

April, 1956: "At the regular March meeting, Xi chapter (Sigma Tau) initiated Doctor Ralph Edward Gibson, director of the Johns Hopkins University Applied Physics Laboratory."

November, 1956: "AIEE-IRE is pleased to announce that their membership now stands in excess of eighty members, a record membership for the branch."

October, 1956: "To further its policy of cooperating with the Dean of the School of Engineering, Sigma Tau Fraternity will henceforth requires its initiates to take diagnostic tests beginning November 10, 1956 . . . Individual results are to be kept confidential."

October, 1956: "The *Engineers' Guide*, a student handbook designed specifically for the engineering student, was printed . . . As a first effort of this type in the School of Engineering, the book was intended to fill a need in orienting the new students in the way of G.W. . . ."



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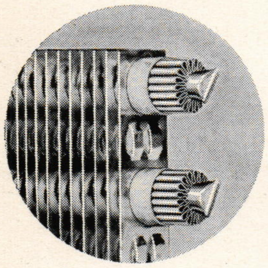
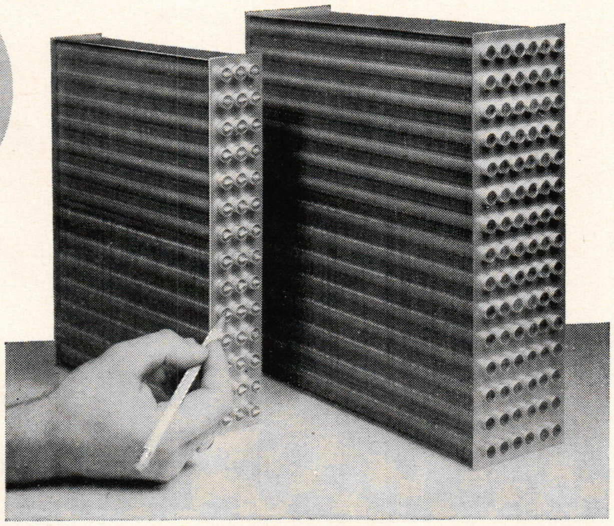


*Inner-fin tube has an "R" factor (internal coefficient) of 5.05. This spirally wound surface is an excellent turbulence promoter. It positively prevents channeling and has the highest value of overall heat transfer coefficient of all types of heat transfer coils.



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While it is true that (numerically speaking) our employee team is small compared to some, we encounter great difficulty in trying to think of Sikorsky Aircraft as a "little pond". Our contributions to the field of rotary-winged aircraft have not been small, nor can our field be considered limited or professionally confining. Quite the contrary. Sikorsky Aircraft is the company which *pioneered* the modern helicopter; and our field today is recognized as one of the broadest and most challenging in the entire aircraft industry.

And what of the size of the "fish"?

Unquestionably, that is a matter involving your own individual potential for growth. Like any far-sighted company, we're always willing to talk with "young whales"!

For factual and detailed information about careers with us, please write to Mr. Richard L. Auten, Personnel Department.

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EFFECTIVE COMMUNICATION

(Continued from page 11)

the Agency where I work recently conducted an open house for the public and the high school students of the local area. As I escorted the groups around to the various laboratories, the representatives in charge of the exhibits would explain the functions of the laboratory and describe some of the products and their operation. The explanations were carefully planned in detail but were too highly technical for the public to comprehend. Some of the students turned to me repeatedly for explanation of certain terminology, some of which I had to admit I was unable to explain. Even such every day terms (to the engineer) as "infinity", "angular acceleration", "reliability", "hardware", and "components" required explanation. The words themselves were understandable but their application in the technical sense became puzzling to the students. Today we are lamenting the shortage of engineers and scientists and are attempting to induce more young people to enter the engineering fields. But in the attempt are we not possibly trying to "glamorize" the engineering fields rather than trying to make them "appealing" and "interesting"?

Mastery of language is an asset for the potential engineer as well as for the practicing engineer. Therefore, development of one's writing, speaking and participating in meetings is of growing importance. Once the student has been induced to enter engineering school, he must be taught in a language understandable to him until he has gained sufficient confidence in himself to enable completion of his curriculum. Sudden and immediate exposure to highly involved and technical texts and terminology, which today are much different from those of 50 years ago, without sufficient clarifying explanations may be considered one reason for the high mortality rate among the engineering students. (It goes without saying that this requirement applies as well during the student's secondary school education.) Not only must engineering subjects be made understandable to the student but they must be made interesting. The student must also be taught the skills of communicaion which he will need upon graduation and entrance into the practical field of his profession.

In concluding, I quote from an editorial in a recent issue of *Electrical Manufacturing,* "In a world in which the engineer and his black art are permeating ever more deeply into our daily lives, the communication of exact engineering meaning is a worthy task. When engineers do not undertake the chore of communications on all levels and in all directions, the vacuum and real need so created is filled by others. Often these others, though well-meaning, are inept in technical matters. One consequence is a vulgarization of ideas that merit more respectful, more accurate comprehension by the general public."

"It should be possible, for instance, to convey engineering concepts, ideas and proposals to management and to others without yielding one iota in accuracy, without playing 'mountebank' and sensationalizing an idea for attention's sake. Leaving communications to persons whose talents lie precisely in their knack for the sensational is not in the long term interest of the stature and dignity of the engineering profession."

The plain fact is that every engineer must be a "salesman" if he is to get anywhere. He must be able to sell his ideas to his associates, to his management, and to the public, to build their confidence and belief in what he is thinking and doing. But in order to sell, the engineer must be able to communicate effectively.

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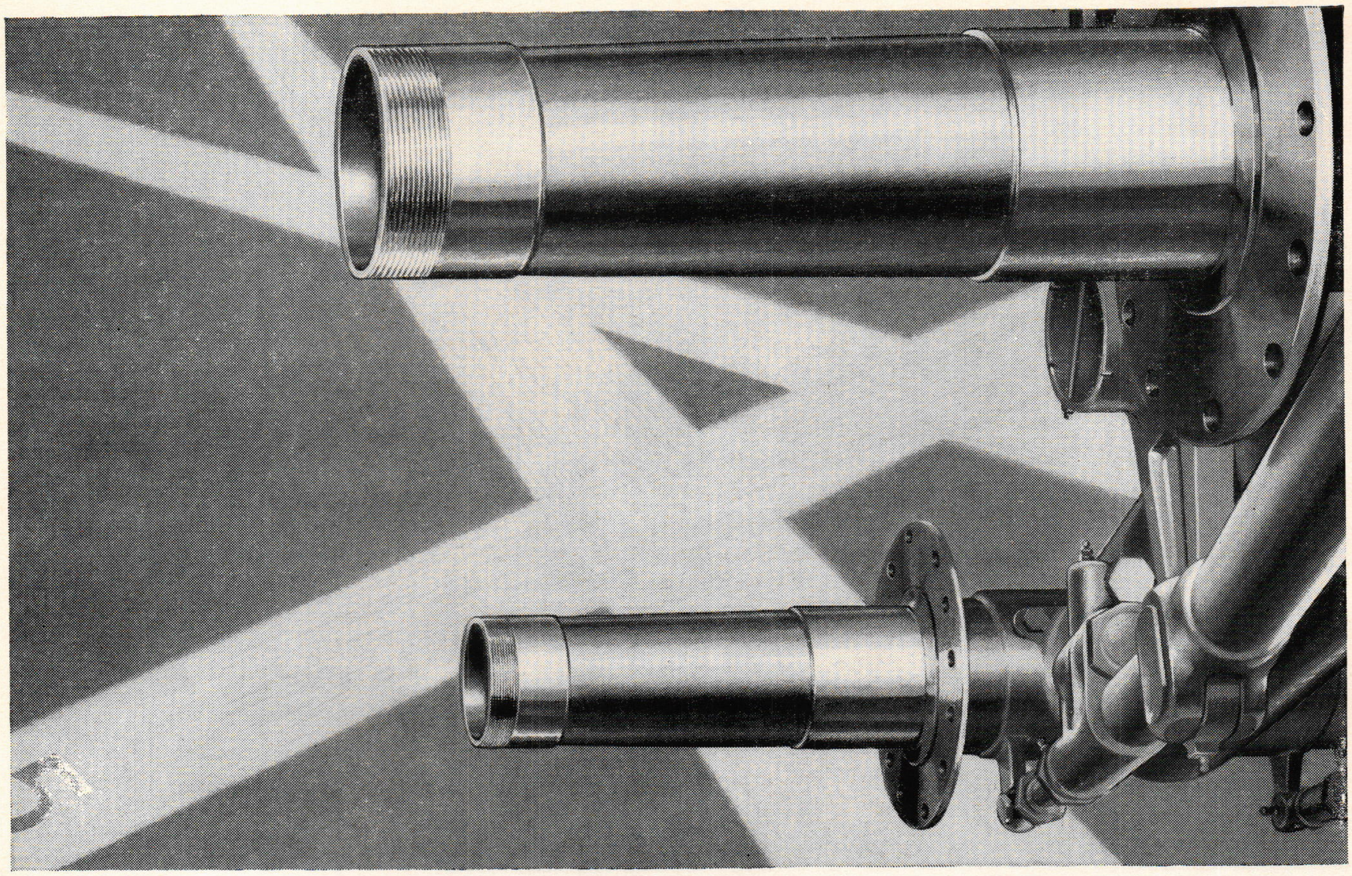
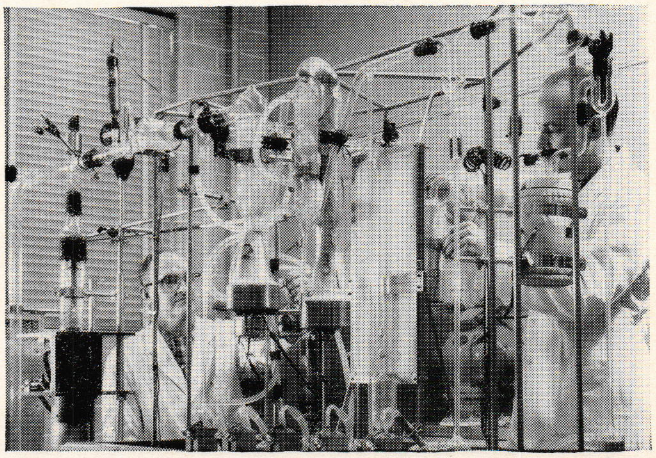


How to get steel tough enough to land America's first jet airliner

YOU see above the axles of the Boeing 707—America's first jet airliner. They have to be tough. A cross-wind landing could put the whole landing impact of this 122-ton plane on one wheel—instead of eight. And these axles have to be light. Manufacturers of the 707's landing gear had built landing gears for dozens of other models using an analysis of seamless steel tubing specially developed by the Timken Company. But to be strong enough for the much heavier 707, the steel would have to be cleaner. Any impurities in the finished part would cause its rejection. Timken Company metallurgists said the steel *could* be made clean enough for the 707. And it was—met highest specifications, stood up to the terrific landing impacts.

Timken steels have solved the toughest steel problems. Problems that you may face in your future job in industry. Our metallurgists will be ready to help you. And if you're interested in a rewarding career with the leader in specialty steels . . . with the world's largest maker of tapered roller bearings and removable rock bits . . . send for free booklet, "Better-ness and your Career at the Timken Company". Write Mr. Russ Proffitt, The Timken Roller Bearing Company, Canton 6, Ohio.



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Slipstick Slapstick

Bum: "Have you got a nickel for a cup of coffee?"
Student: "No, but I'll manage somehow, thank you."

Engineer: "But sir, isn't this the same exam you gave last year?"
Professor: "Yes, but I've changed the answers."

A customer sat down at a table in a smart restaurant and tied a napkin around his neck. The manager called the waiter and said, "Try to make that man understand as tactfully as possible that that's not done here."
The waiter approached the customer and said, "Shave or haircut, sir?"

I serve one purpose in this school
Upon which no man can frown;
I quietly sit in every class,
And keep the average down.

"I said some very foolish things to my date last night."
"Yes?"
"That was one of them."

A Cuban was describing his country to an American woman: "Our most popular sport is bull fighting," he told her.
"Isn't it revolting?" she asked.
"No," smiled the man, "that's the second most popular sport."

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Truck driver stopped beside stalled Volkswagen on highway: "What's the matter, buddy—need a new flint?"

"What's your hurry?"
"I bought a new textbook and I'm trying to get to class before the next edition."

Two rabbits were being chased by a pack of wolves when one turned to the other and said:
"What are we running for; let's stop and outnumber them."
The other rabbit replied:
"Keep running, bud, keep running—we're brothers."

Just heard about an EE who flunked out last semester. He now works for a cremator, selling ashes to cannibals as "instant people".

A bosom companion sometimes turns out to be a false friend.

"Will you be free tonight?" asked the ME.
"No, but I'll be reasonable," she replied.

After feeling his way around the lamp post several times, the sozzled engineer muttered, "S'no use; I'm walled in."

A nickel goes farther now than it ever did—you have to carry one for weeks before you can find anything it will buy.

"Darling," she whispered, "will you still love me after we are married?"
"I think so," replied the ME; "I've always been especially fond of married women."

Returning from the funeral of his beloved wife, the widower was very disconsolate.
"I know how deeply grieved you are," said his friend, "but you're young and in time you will forget. You'll meet someone else with whom you will share real happiness."
"I know, I know," said the husband, "but what about tonight?"

"Just because my eyes are red is no sign I'm drunk," pleaded the CE. "For all you know, I may be a white rabbit."

Once upon a time there were three coeds—a great big coed, a middle-sized coed, and a little coed—who went for a walk in the woods. When they came back they were very tired and wished to go to bed. So they went to their rooms.

"Someone's been sleeping in my bed," said the great big coed in a great big voice.

"Someone's been sleeping in my bed," said the middle-sized coed in a middle-sized voice.

"Good night, girls," said the little coed in a little bit of a voice.

The young man started work as a stockroom boy. Within six months he was made a salesman. In another six months he was upped to salesmanager, and shortly thereafter he was made general manager.

A few days later, he was called in by the president of the firm, who explained that he would retire soon and would turn the presidency over to the newcomer.

"Thanks," said the young man.

"Thanks!" growled the president. "You've been with this firm a little over a year. Is that all you can think of to say?"

"Well," said the young man, "thanks a lot, dad."

"Hey, dad, I'm home from school again."

"What the devil did you do this time?"

"I graduated."

A Texan, newly arrived in England, was playing poker with a couple of the natives. He was pleasantly surprised upon picking up an early hand to see four aces in it.

"I'll wager a pound," said the Britisher on his right.

"Ah don't know how y'all measure yore money," drawled the Texan, "but Ah reckon Ah'll have to raise you about a ton."


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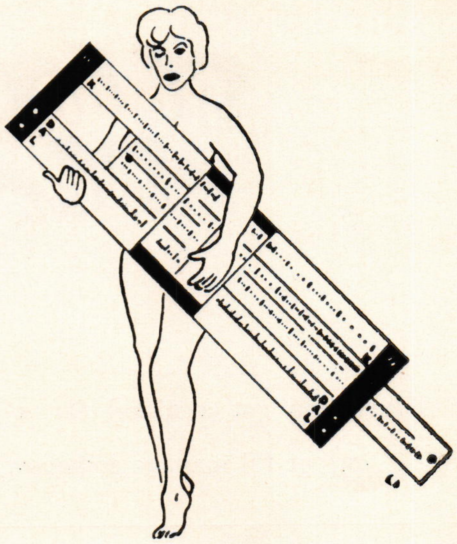


Two wealthy industrialists fell into an argument about whether the Russians were really our friends or not. The one who maintained that they were said, "Why, I'll bet I could ride a Russian ship to Russia, tour the country, and return, and nothing at all would happen to me."

The other man called his bet and the sum was set at one million dollars. Two weeks later as the Russian ship left New York harbor, the ship's captain called the American from his cabin. "We haff cable for you from New York, friend," he snarled. "Read it!"

The American, puzzled at the Captain's belligerent manner, looked at the cable. It read: "If you can't get Khrushchev, try for Mikoyan."

According to a story going around Western Europe, one Prague resident refused to join the outcry against a new Stalin statue in the city's public square.

"Why not a statue?" he was heard to say. "It gives us shade in the summer, shelter in the winter, and an opportunity for the birds to speak for us all."

Probably the reason that God made woman last was that he didn't want any advice while creating man.

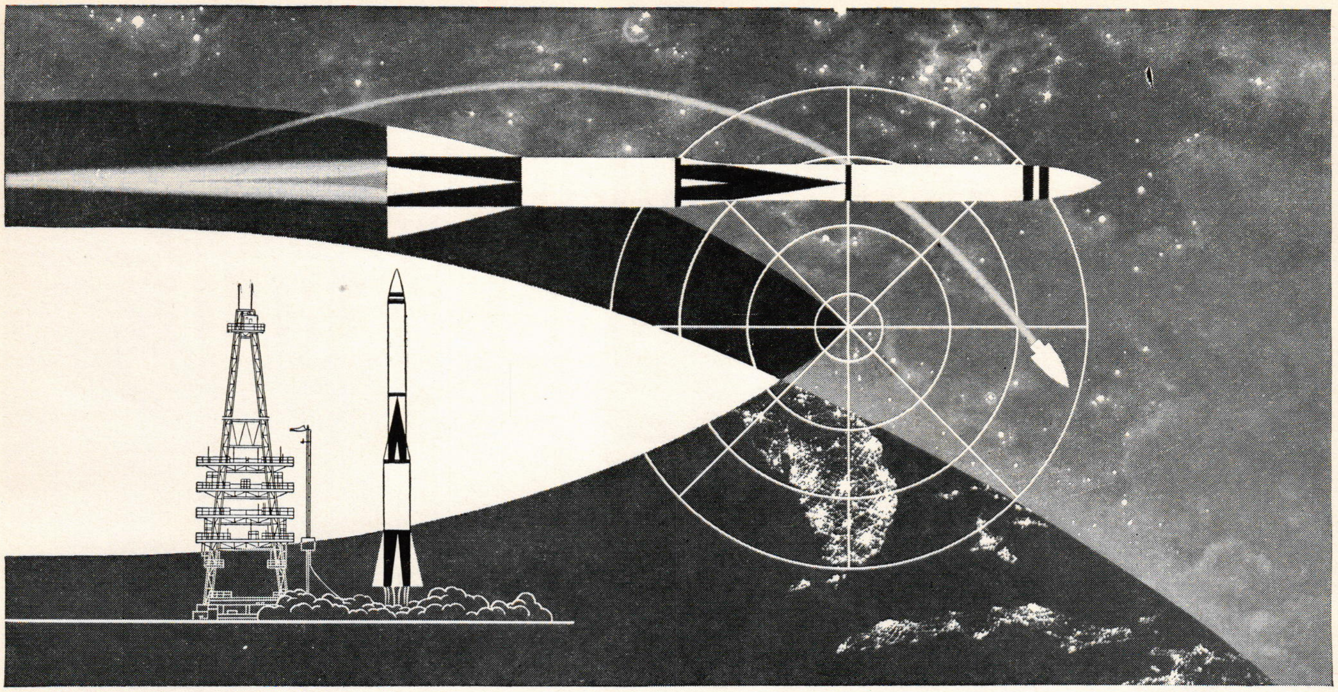
C.E.: "Say, buddy, can you let me have twenty cents for a cup of coffee?"

Man: "But coffee is only a dime."

C.E.: "I know, but I have a date."

Pilot to tower: "Plane out of gas; am one thousand feet and thirty miles over ocean. What shall I do?"

Tower to pilot: "Repeat after me—'Our Father who art in heaven . . .'."



• An artist's conception of the launching of the missile, its guided flight, its track on a radarscope in its final stage.

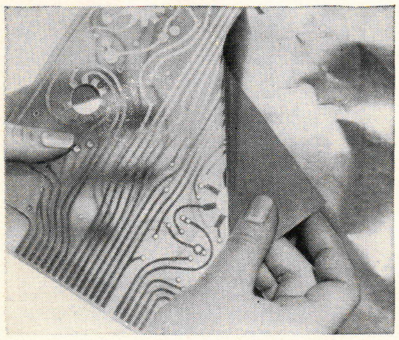
MINIATURIZATION for the MISSILE AGE

Another new design frontier for copper

"The increasing amount of equipment carried on military aircraft . . . has made it necessary for the design engineer to cram more equipment into less space."

"To achieve maximum usefulness from miniaturization, all elements of the system must be reduced to the same order of size. New design techniques, components and production methods have been developed to aid the designer in reaching this goal."
— *Electronics* Magazine

Many of these new design techniques are taking advantage of the properties of a very old material — copper. One of copper's big jobs is conducting electricity in control circuits. Of course, copper is the best commercial conductor, but when miniaturization takes over, many other properties of copper also become important.



Printed circuit of copper bonded to epoxy glass base, and sheet of the adhesive-backed copper used in its manufacture by Rubber & Asbestos Corp.

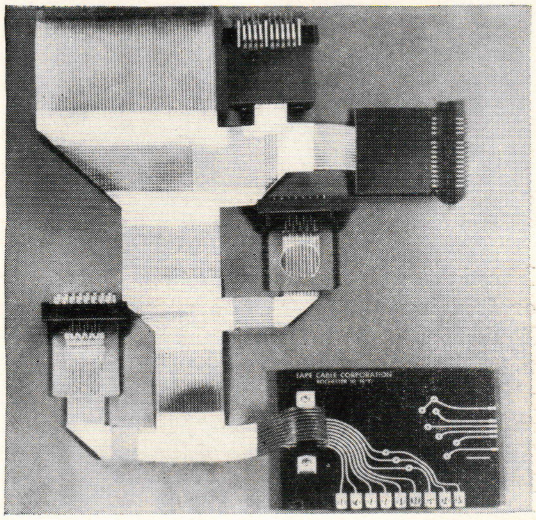
In the printed circuits that are the very basis of most subminiature designs, the conductors may start out as a sheet of copper foil. This foil often has to be very thin — yet free of flaws that might cause circuit discontinuities. Here, copper's ductility is vital.

Good joining properties are also important. Some of the tiny connections are resistance welded. (Copper can withstand the temperatures.) Others are soldered. (Easily done with copper and with very little solder metal.)

Complex control circuits can now be wired with flexible Tape Cable. This tape may contain as many as 50 copper conductors, side by side — and weigh only 2½ pounds per 100-ft. roll. The standard size of each of the rectangular conductors in the tape is 0.0015 in. by 0.03 in.

Obviously, with such small cross sections, no deterioration of the conductor is permissible. Yet temperatures, particularly in missile applications, are high. The answer is found in copper which is free of oxygen—eliminating oxidation, scale formation and conductivity losses.

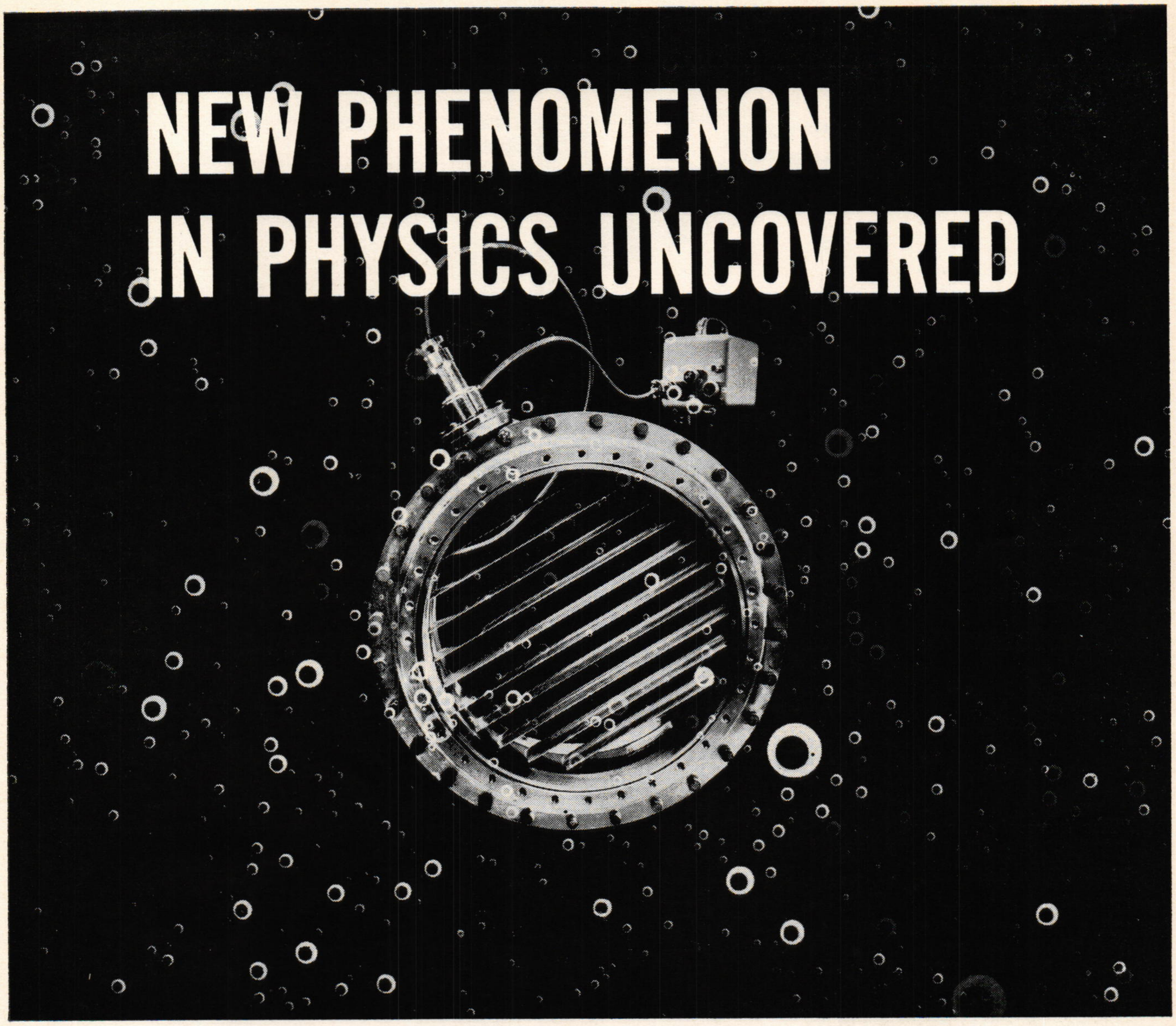
In other high temperature applications, copper's high thermal conductivity can be used to protect more delicate parts from excessive heat. For this reason it is useful in missile nose cones. And, of course, copper's excellent corrosion resistance is often valuable in exposed parts and in tubing.



Wiring harness of Tape Cable provides flexible, flat 50-conductor interconnection system.

The field of missiles and rocketry is but another example of a design frontier where the versatility of copper and the copper alloys helps make progress possible.

If you'd like to know more about these metals and their design possibilities, send for "A Guide to Copper and its Alloys." Write The Copper & Brass Research Association, 420 Lexington Avenue, New York 17, New York.



Investigation in detecting cavitation, or forming of vapor bubbles in liquid flow, led AiResearch engineers to the discovery of an important new phenomenon . . . *that flow of bubbles in liquids generates a magnetic field.* This discovery, among other things, helps solve critical flow problems in missile and industrial fields. The AiResearch cavitation detector pictured picks up these tell-tale signals as the liquid passes through the grid, pinpointing the cause of trouble.

Many such pioneering developments are underway in challenging, important work at AiResearch in missile, electronic, nuclear, aircraft and industrial fields.

Specific opportunities exist in system electronics and servo control units; computers and flight instruments; missile auxiliary power units; gas turbine engines, turbine and air motors; cryogenic and nuclear systems; pneumatic valves; industrial turbochargers; air conditioning and pressurization; and heat transfer, including electronic cooling.

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- **Advanced education is available through company financial assistance at nearby universities.**

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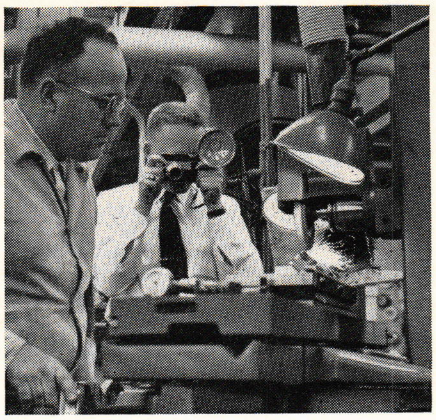
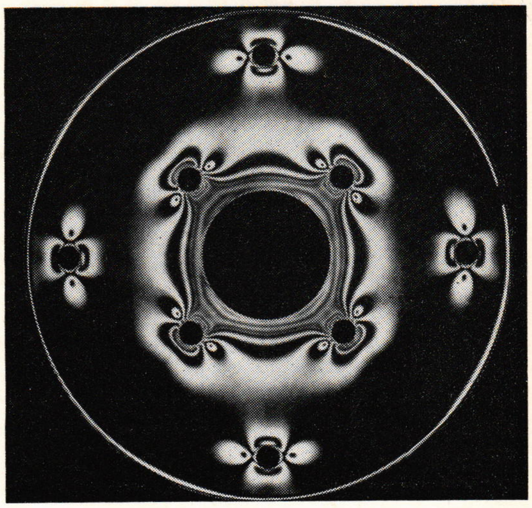
From research to finished product–

Photography works with the engineer



Sparks fly as the plant photographer records a grinding technique for study.



Photoelastic stress analysis helps the design engineer pinpoint areas requiring extra strength.

Giant machines produce a flow of photo-exact engineering drawings—save countless hours of drafting time.

Today photography plays many important roles in industry. It speeds engineering and production procedures. It trains and teaches. It sells. In whatever work you do, you will find photography will play a part in improving products, aiding quality controls and increasing business.

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With photography and photographic processes becoming increasingly important in the business and industry of tomorrow, there are new and challenging opportunities at Kodak in research, engineering, electronics, design and production.

If you are looking for such an interesting opportunity, write for information about careers with Kodak. Address: Business and Technical Personnel Dept., Eastman Kodak Company, Rochester 4, N.Y.

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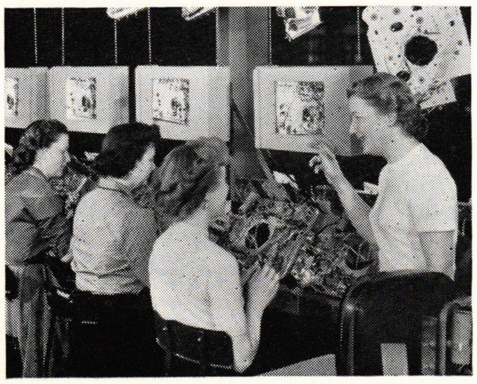

Color transparencies on the production line aid operators in assembly operations—save time and reduce errors.

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Interview with General Electric's
Earl G. Abbott
Manager—Sales Training

Advancement in a Large Company: How it Works

Where do you find better advancement opportunities—in a large company or a small one? To help you, the college student, resolve that problem, Mr. Abbott answers the following questions concerning advancement opportunities in engineering, manufacturing and technical marketing at General Electric.

Q. In a large Company such as General Electric, how can you assure that every man deserving of recognition will get it? Don't some capable people become lost?

A. No, they don't. And it's because of the way G.E. has been organized. By decentralizing into more than a hundred smaller operating departments, we've been able to pinpoint both authority and responsibility. Our products are engineered, manufactured and marketed by many departments comparable to small companies. Since each is completely responsible for its success and profitability, each individual within the department has a defined share of that responsibility. Therefore, outstanding performance is readily recognized.

Q. If that's the case, are opportunities for advancement limited to openings within the department?

A. Not at all. That's one of the advantages of our decentralized organization. It creates small operations that individuals can "get their arms around", and still reserves and enhances the inherent advantages of a large company. Widely diverse opportunities and promotions are available on a Company-wide basis.

Q. But how does a department find the best man, Company-wide?

A. We've developed personnel registers to assure that the best qualified men for the job are not overlooked. The registers contain complete appraisals of professional employees. They enable a manager to make a thorough and objective search of the entire General Electric Company and come up with the man best qualified for the job.

Q. How do advancement opportunities for technical graduates stack-up with those of other graduates?

A. Very well. General Electric is recognized as a Company with outstanding technical skills and facilities. One out of every thirteen employees is a scientist or engineer. And approximately 50 per cent of our Department General Managers have technical backgrounds.

Q. How about speed of advancement? Is G.E. a "young man's Company"?

A. Definitely. A majority of all supervisors, managers and outstanding individual contributors working in the engineering function are below the age of forty. We believe that a job should be one for which you are qualified, but above all it should be one that challenges your ability. As you master one job we feel that consideration should be given to moving you to a position of greater responsibility. This is working, for in the professional field, one out of four of our people are in positions of greater responsibility today than they were a year ago.

Q. Some men want to remain in a specialized technical job rather than go into managerial work. How does this affect their advancement?

A. At G.E. there are many paths which lead to higher positions of recognition and prestige. Every man is essentially free to select the course which best fits both his abilities and interests. Furthermore, he may modify that course if his interests change as his career progresses. Along any of these paths he may advance within the Company to very high levels of recognition and salary.

Q. What aids to advancement does General Electric provide?

A. We believe that it's just sound business policy to provide a stimulating climate for personal development. As the individual develops, through his own efforts, the Company benefits from his contributions. General Electric has done much to provide the right kind of opportunity for its employees. Outstanding college graduates are given graduate study aid through the G-E Honors Program and Tuition Refund Program. Technical graduates entering the Engineering, Manufacturing, or Technical Marketing Programs start with on-the-job training and related study as preparation for more responsible positions. Throughout their G-E careers they receive frequent appraisals as a guide for self development. Company-conducted courses are offered again at all levels of the organization. These help professionals gain the increasingly higher levels of education demanded by the complexities of modern business. Our goal is to see every man advance to the full limits of his capabilities.

If you have other questions or want information on our programs for technical graduates, write to E. G. Abbott, Section 959-9, General Electric Co., Schenectady 5, N. Y.

***LOOK FOR other interviews discussing: • Qualities We Look For in Young Engineers • Personal Development • Salary.**

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